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Practical operating data on electropolishing of various metals.

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424 S. Broadway, Los Angeles 13, Cal.
Mutual 7827

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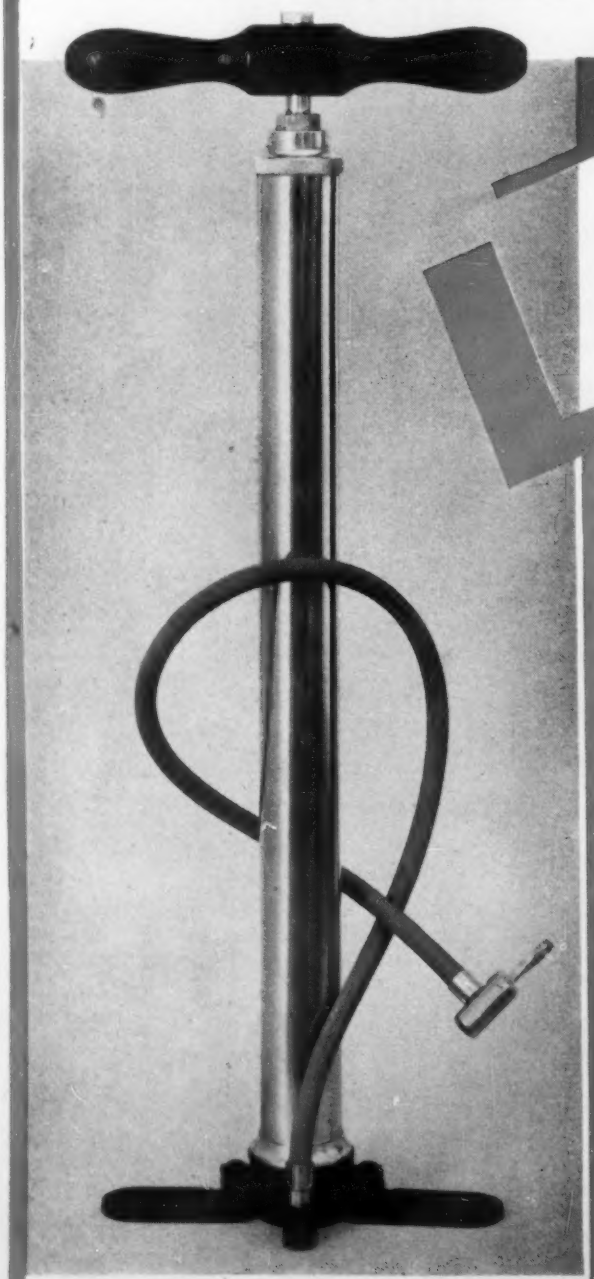

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The Facts About Beryllium Alloys

Recently there has appeared in the newspapers several reports on the poisonous nature of Beryllium and the hazards involved in working alloys containing this metal. Grinding, polishing, and buffing operations were mentioned as being in this hazardous category.

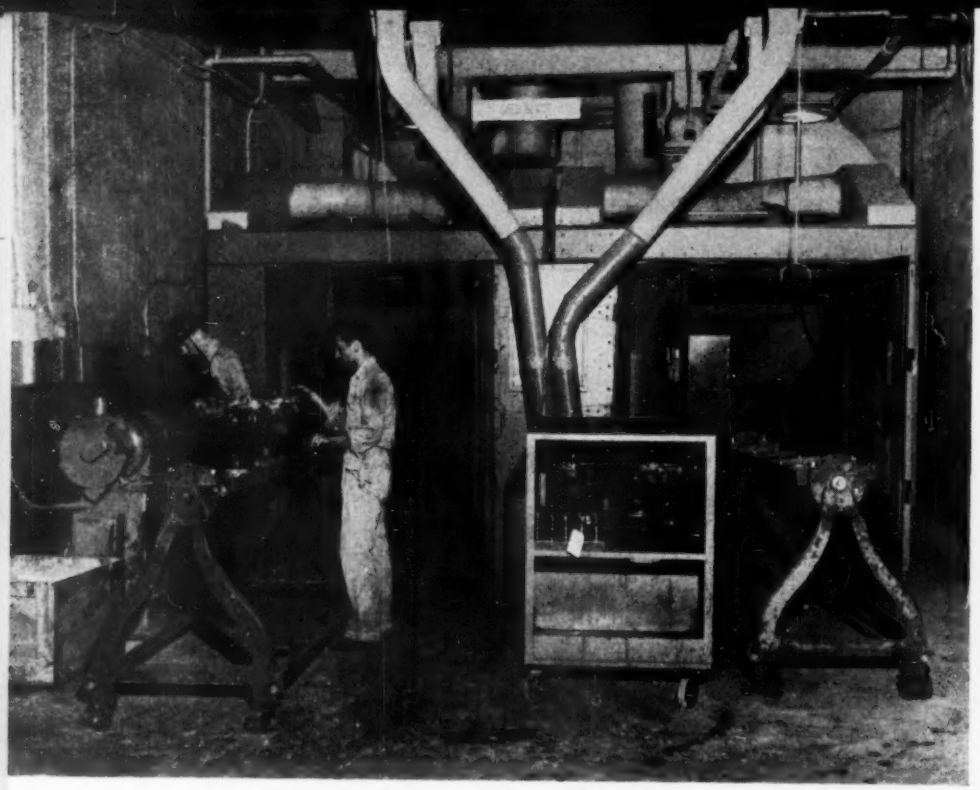
In one report all kinds of horrible effects were described, including breaking out of the skin, development of a "peculiar" type of pneumonia, loss of appetite, etc. Particularly gruesome was the statement that these effects might not be observed for months or even years after exposure, and that there was no known cure. After reading this article we wouldn't blame the average shop man, whether he was a machinist, polisher, or plater, for not wanting to touch beryllium-containing alloys with a ten-foot pole!

Needless to say, this type of report could cause much confusion, and many engineers might relegate beryllium alloys to the class of undesirables, despite the widespread use and value of these important materials. Serious restraint of their use could be the result.

However, as is usually the case in reports of this kind, the author left out some mighty important facts. Investigation reveals that it is not metallic beryllium nor its alloys which were the cause of the reported afflictions, but chemical compounds and salts of beryllium such as are used in the manufacture of fluorescent tubes, among other things. Beryllium forms a number of soluble salts which are toxic if inhaled or taken internally, but no more so than equivalent compounds of lead or copper, which must also be handled with due respect and care.

The overwhelming experience of a large number of metal working plants that have handled beryllium alloys over a long period of years is that there are absolutely no more hazards involved in working these materials than there are in working with other metals.

It is hoped that this information will help to allay any fears that may have developed in the minds of polishers and buffers in connection with putting a decorative or functional finish on the alloys of beryllium. Competent medical investigators have given beryllium a clean bill of health with respect to any occupational hazards attending their use.



Cleaning Surfaces by Non-Erosive Blasting

By Joseph Albin, *New York City.*

This method of cleaning, also known as seed or soft-grit blasting, promises interesting applications in the metal finishing field. This article describes its use in airlines maintenance for cleaning engine parts without causing abrasion of critical surfaces. Details of production methods, economy and flexibility of the process are discussed.—Ed.

SEED blasting, like sandblasting, cleans metallic surfaces of soils extremely difficult to remove by chemical means, such as the tenacious carbon and oxide deposits in airplane and automotive engines. Seed blasting has an advantage over sand blasting in that scoring or abrading of the metal is avoided. Protection of critical or highly finished surfaces, as when using sand or steel grits, is unnecessary. There is a considerable saving of time and labor in the elimination of operations ordinarily required to protect the surfaces, such as the use of rubber plugs, gaskets, or other masking means. In the case of an outstanding airline overhaul shop, a 50% decrease was realized in the time required for production cleaning of engines, using only one-half the manpower previously required when sandblasting was employed.

As a method of cleaning which avoids erosion, seed blasting has considerable possibilities in the preparation of the surfaces of metals for subsequent plating, painting or other corrosion protection finish. Dimensional control is not disturbed, an especially important factor when the parts are made of aluminum alloy or other soft non-ferrous metal.

Seed or soft-grit blasting first came into use in an Army Air Forces establishment on the West Coast during the war. While on the job of cleaning aluminum cylinders and pistons, a civilian employee substituted clover seed for sand in the standard sandblast equipment to see how it would do the job. The very satisfactory results of that trial were immediately recognized. The research and engineering facilities of the Air Forces and of the private airlines went into action, and have succeeded in bringing the process to a successful industrial plane.

There is no problem of special equipment. The concern equipped for sandblasting can commence operations with soft grits immediately. A variety of grits have been utilized in production ranging from coffee grounds, a waste material from coffee extraction plants, to specially prepared plastic pellets. Among other grits that have been tried are bird seed, clover seed, cracked wheat, ground coconut shell, and ground corn cobs. Peanut shells, which first appeared to give promising results, were eliminated because of sand contamination. Rice hulls have been found too hard for certain parts, although it is possible that they would be usable for some applications. There is also the possibility of sand contamination here. Nylon

All photos by courtesy of American Airlines.

pellets did not produce the results anticipated. Other plastic pellets for blasting purposes are made from Methyl Methacrylate and Cellulose Acetate materials. The matter of expense enters when plastic powders are used, the cost being quite a bit higher than the other materials mentioned. A grit made by grinding walnut shells has desirable uniformity of mesh. It is marketed as a blasting powder by a number of California companies under various trade names.

Seed blasting has an added advantage of flexibility. Air pressure can be readily regulated to accord with the kind of soil to be removed, the hardness of the grit and of the metal. It is possible to produce a frosted surface, but once the air pressure has been nicely adjusted to the particular grit, carbon and oxide deposits can be flushed from the metal with the first pass of the blast hose.

Besides the pressure and volume of air used, and particle size distribution and shape of the grit, application can be affected by moisture content, which counts as a factor in line clogging. Sand, as noted above, is a contamination that usually enters in the course of gathering or processing some products used for grits. Oily residues are other contaminations. The effect produced by oils is a thin hardly visible coating of hardened oil on the blasted surface which can be troublesome, especially where there are threaded parts having close fits.

Service life and economy of the grit depends on the breakdown of the particle. Retention of particle shape after cleaning should be compared with shape before working. The particle which preserves a sharp outline should be preferred to one which becomes rounded or shreddy. Grits can further be studied by a sieve analysis before and after cleaning to determine particle size and percent dust. When to eliminate grit and start with fresh batch can usually be determined by the darkness of the particles, resulting from imbedding of the soil being removed.

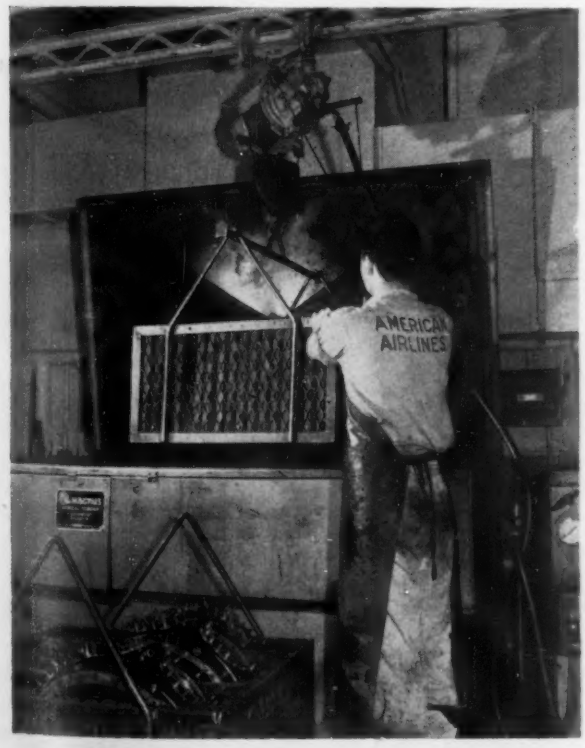


Fig. 1. Preliminary soak in chemical solvent loosens resins which cause adhesion of oxides and carbon to cylinder walls.

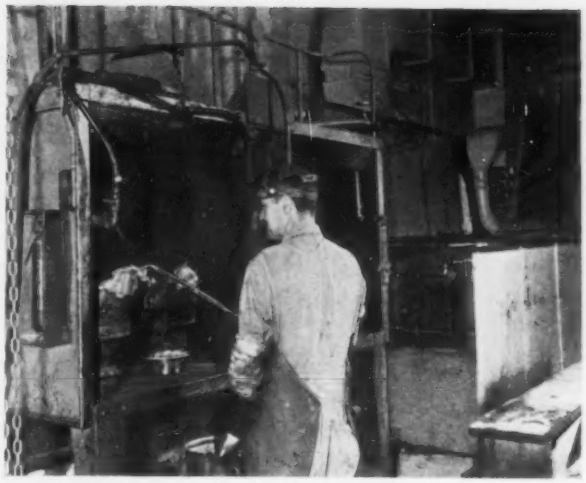


Fig. 2. Parts are sprayed with light oil and air at high pressure. Drying follows using air alone. Parts are now ready for blasting with seed.

Explosion hazards and ignition characteristics of grit materials have received study. Cracked wheat requires special precautions. Because of the ease with which cracked wheat breaks down to a fine dust, there may be the usual explosion problems that exist with all materials of this nature. Adequate separation and collection of these fines must then be incorporated into the equipment. There is also the matter of storage properties, which involves vermin and water effects, the plastic grits being excluded.

In addition to the foregoing considerations, the price of some grits may balance the advantages experienced in time and labor saving. The cost per pound of these products may vary from a few cents to over a half dollar. An approximate cost of the various types of soft grit materials is as follows:

Cracked Barley, Hominy Grits, Peanut Hulls, Rice Hulls, Coconut Shells	4-6 cents/lb.
Coffee Grounds	5-7 cents/lb.
Cracked Wheat	6-9 cents/lb.
Ground Walnut Shells	15-20 cents/lb.
Plastic Grits	55-75 cents/lb.

Although the plastic materials are relatively costly, they have in their favor longer life, are not explosive in storage, are vermin proof, and generally are not affected by moisture. In spite of the higher first cost, for certain installations the plastic pellets would be the logical choice. One of the least expensive grits is ground coconut shells. Although the mesh may be large, coconut shells are known to give good results. There is the disadvantage of possible contamination by sand which sometimes gets attached to the fibers of the shell as they are picked off the ground. However, for the cleaning of certain parts and areas, the slight lack of uniformity in results secured with the coconut grit can be ignored. Since most of the grits are made

from waste products, the question of availability is not an important one. It has been the experience of certain overhaul shops to change from clover seed to cracked wheat to walnut shells within the space of weeks, the alternations being not of great moment as accommodations for changes in the hardness of the particular particle used are made by altering air pressure and volume.

Mesh sizes vary between 12 and 60, depending on the type grit used. In the case of coffee grounds, a 30 mesh is average. This grit has been used to clean airplane engines. For deburring precise and fragile hydraulic parts in aircraft installations where it is necessary to remove every metal particle, walnut shells obtained in grades of 20 to 40 mesh have the desired abrasive qualities. The medium is air-forced at the parts at 60 to 75 p.s.i. pressure. The average range of air pressure with most soft grits is between 60 and 90 lb. In connection with the deburring of hydraulic valve bodies it warrants mention that, originally, hand removal of burrs was justified to obviate the danger of metal particles being lodged under a valve poppet seat and which were likely to scratch the highly finished surface of a honed sealing area. At first sand particles were used in an attempt to increase production, a special airblast cabinet being designed for the purpose. However, the action of the sand was found to be too harsh on metals of relatively low density. When clover seed and sesame seed were substituted for the sand, rejects sharply fell. A change was made to walnut shell which could be used over and over again until a dark color was noted indicating too many metal chips. Production costs were greatly reduced, and this material proved very satisfactory.

The seed blasting layout in the La Guardia Field

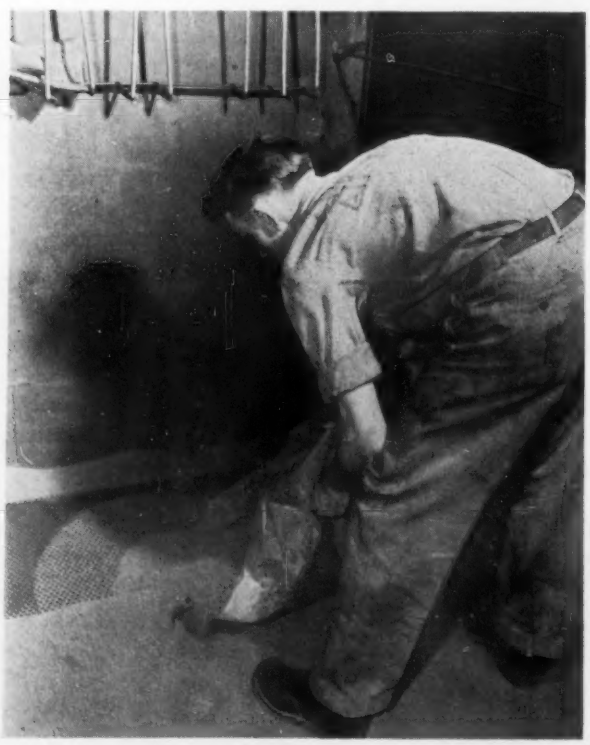


Fig. 3. Unloading a bag of ground walnut shell into the suction bin of the blast booth. Other grits used are bird seed, clover seed, cracked wheat, and coffee grounds.

Fig. 4. Removing carbon and oxide deposits from cylinder heads by the seed blasting method. Part is ready for reassembly in engine without additional polishing.

overhaul shops of the American Airlines is a compact one and representative of a highly efficient type. The blasting not only performs the essential cleaning operation on cylinder heads and pistons but also polishes them so that they come out of the blast booth in a state ready for reassembly in the engine.

To help dissolve the resins which are responsible for the tenacious adhesion of carbon deposits to the walls of the cylinders, a series of preliminary chemical dips are provided. Accumulated grime and paint is also removed by the dips. Two results accrue from the dips; the first is that blasting is speeded up, and second, the contamination of the grit is lessened. Parts are conveyed in baskets and lowered into the baths by compressed air lifts, as shown in Fig. 1. They receive a preliminary soak in oleum, a light viscosity oil resembling kerosene, for 15 minutes, primarily to remove surface dirt and grime. They are then placed in a chemical cleaner for 1½ hours at 130°F. The American Airlines are particular in the avoidance of surface darkening or erosion by this chemical treatment.

Following the dips, the individual piece is given an oleum spray mixed with air at 80 lb. pressure in a cabinet spray booth, as illustrated in Fig. 2. Drying operation follows using the air stream alone.

Parts are now ready for seed blasting which is done with equipment standard for sandblasting. The operation is completed in the booths shown in the title picture. The dust removal apparatus and blow-off hoppers are located at the top of the cabinets. The grit is dropped into the suction bin located in the floor of the booth (Fig. 3). The cylinder heads are mounted on a rotatable fixture. After the operator has sprayed the top, the fixture is turned to expose the other side. It requires 20 minutes to thoroughly clean and polish a cylinder head, the interior as well as the rocker boxes and the outside fins. Air pressure of 60 lb. is used with ground walnut shell.

Figure 4 shows the operator performing the actual

(*Concluded on page* 61)

Rectifiers for Electroplating—Part V

By Louis W. Reinken, *Chief Engineer, W. Green Electric Company, Inc., New York City*

Previous articles in this series on rectifiers appeared in February, April, May, June and September, 1947. These have been reprinted and a complete set of the earlier articles will be sent on request to the author. Also, reprints of the current and subsequent articles will be sent automatically so that you may have them available in one folder without clipping your file of METAL FINISHING.—Ed.

IN ONE sense, the entire aim of the electroplating superintendent is to reproduce consistently, in large quantity, the results obtained on a small scale in the laboratory. An ideal production run would have zero rejects and each piece would be identical with all others in appearance, quality, and thickness of deposit. This is a good trick if you can do it!

In the quest for uniformity, one variable after another has been tracked down, analyzed, and brought under either manual or automatic control. Modern plating procedure includes, as a matter of course, regular sampling and adjustment of bath composition, automatic control of temperature, bath agitation, continuous filtering, regular inspection and replacement of anodes, controlled time of immersion, and of course the electrical variables of tank voltage, tank amperage, and current density.

Top management, while encouraging uniform "zero-reject" production, must balance the dollar-variables which include the costs of labor, electrical power, investment in equipment, and factory space. On the dollar basis, automatic stabilization (of voltage or current) cannot be recommended indiscriminately for *all* plating shops and for *every* plating or anodizing process. The equipment necessary for automatic stabilization is inherently expensive and the additional investment can be justified only where stabilization of the electrical variables will produce a real dollar economy.

Automatic Stabilization

In general, automatic stabilization is of practical use in three kinds of installations:

(1) Where the process is extremely critical to voltage and requires accurately maintained potential for satisfactory results. An example of this might be the color-plating process which depends upon interference patterns for the color effect.

(2) Still tank plating in which it is desired to maintain constant voltage across the tank regardless of the amount of work in the tank at any time. An example of this might be a hard chrome setup in which automatic voltage stabilization will re-

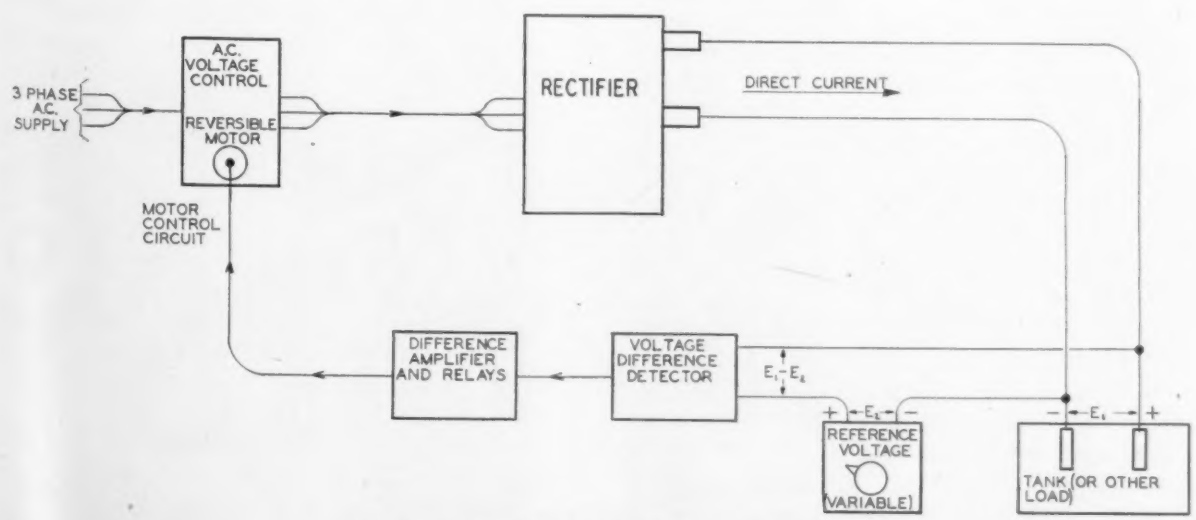


Fig. 27. Block schematic-automatic voltage stabilizer.

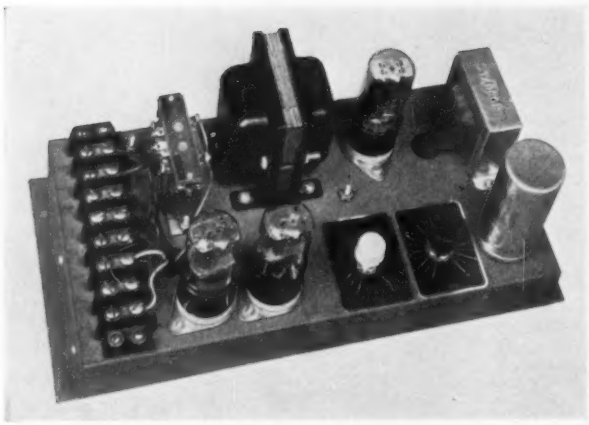


Fig. 28. Early type electronic tube detector and amplifier for automatic voltage stabilization.

lieve the operators of meter supervision and leave them free to concentrate on racking the work and timing the individual racks.

(3) Full automatic machines turning out considerable quantities of identical pieces. Once the machine has been fully loaded and is running at a definite time cycle, it is possible to ensure uniform ampere-hours (i.e., uniform thickness) by switching the rectifier equipment over to automatic *current* stabilization. Total *amperes* delivered to the machine will be maintained constant.

Voltage and Current Stabilization

A distinction must be made between two different kinds of electrical stabilization—*voltage* and *current*. In the first case, the control equipment continuously measures the voltage across the tank terminals and maintains the voltage constant. For example, if the control is set for "5 volts", then the potential across the tank will be maintained at 5 volts (within very narrow limits), regardless of how much work is in the tank. This means that whether there is one rack in the tank drawing, let us say, 200 amperes, or two (400 amperes), or ten (2,000 amperes), the automatic control will correct for the increased voltage drop in the power supply and busbar system, and will automatically readjust the tank potential to 5 volts within a few seconds after each new rack is lowered into the tank. Similarly, correction will be made automatically as racks are removed from the tank.

Such an automatic control will compensate not only for changes in the current drawn by the tank, but also for variations in the AC supply line voltage. In many plants, especially those located at some distance from the power supply substation, there is a change in AC supply line voltage during the course of the day. During the usual factory lunch period, the line voltage may rise from 420 to possibly 460 volts or more, and toward the close of the day (as the lighting load increases) may drop below the nominal line voltage. These changes, which would otherwise be reflected as corresponding changes in the DC tank voltage, are eliminated when automatic voltage stabilization is used.

Automatic *current* stabilization does not maintain constant tank *voltage*. It maintains constant tank *amperes*. Provided the area of work being plated is also constant, this means that the current density, or amperes per square foot, will also be constant; and therefore, the thickness of the deposit in any given period of time will be the same for each piece of work so processed. For these reasons, current stabilization is particularly suited to full automatic plating machines during a repetitive job.

From Ohm's law—

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}}$$

it is obvious that a desired current value can be maintained constant only if the load resistance and corresponding voltage range are within practical limits. If the characteristics of a plating bath are such that a particular area of work will normally draw in the region of 100 amperes current at recommended plating voltages, then one cannot expect the automatic current stabilizer to force 2,000 amperes through the same work. All that will happen is that the stabilizer will drive the tank voltage up to the maximum obtainable from the associated rectifier equipment and then quit. Since it is unlikely that the rectifier can deliver twenty times the normal process voltage, the arbitrary 2,000 ampere value will not be reached.

The automatic current stabilizer is intended to function effectively within normal operating ranges, and in effect simply raises and lowers the tank voltage slightly to compensate for variations in tank resistance due to temperature changes or changes in the resistance of solution and anode surfaces.

Compensation is made automatically for variations in the AC supply line voltage and, in some plants, this may be sufficient in itself to warrant the installation of automatic current stabilization equipment.

Theory of Stabilizer Design

As shown in the block diagram (Fig. 27), an automatic voltage stabilizer is a servo-mechanism which is comparatively simple in *principle*. (More about practical design considerations later.)

Between the rectifier unit, which consists essentially of the stepdown transformer and rectifier elements, and the AC power supply source, is inserted an AC voltage control. This control, which is generally a variable anto-transformer but may also be an induction regulator, is equipped with reversible motor drive. Thus, by energizing the motor to drive in the required direction, to increase or decrease the AC voltage supplied to the rectifier unit, and stopping the drive at the proper moment, it is possible to obtain at the rectifier terminals and the tank any DC voltage within the range of the equipment.

The next step is to add equipment which will measure the voltage across the tank and *automatically* operate the motor on the AC voltage control to keep the tank voltage at a constant, preselected value. Three elements are required for this, and although they are

shown as separate items in the block diagram, they are usually combined in one compact package.

The first of these three elements is a reference voltage. This must deliver a DC voltage which is substantially constant (independent of fluctuations in AC supply voltage, for example) and which can, by means of a control knob, be conveniently varied over the same range of voltage as that obtainable from the rectifier. This variable reference voltage is marked "E2" on the block diagram, and the tank voltage is identified as "E1".

These two voltages are connected in series *opposing* (i.e., negative to negative), and the net difference in potential (E1-E2) is fed into the voltage detector. It will be noted, from the + and − markings on the schematic, that when E1 = E2—i.e., when the tank voltage is the same as the reference voltage, then the potential difference supplied to the voltage difference detector is zero. This corresponds to the situation when no action is required and, of course, the voltage difference detector has zero input signal and does not take action.

If the tank potential E1 is greater than E2, then a potential difference (E1-E2) is supplied to the input of the voltage difference detector. For convenience this difference, when E1 is greater than E2, may be arbitrarily called a "positive" difference. When E1 is less than E2, there is again a potential difference signal but the polarity is now reversed and this would be called "negative".

Thus, with the circuit shown, we have an arrangement whereby the device labelled "voltage difference detector" will be subjected to DC signals of the following types:

(1) A potential of "positive" polarity if the tank voltage is greater than the reference voltage.
(2) A potential of "negative" polarity if the tank voltage is less than the reference voltage.
(3) Zero potential when tank voltage is the same as the reference voltage.

The foregoing tabulation of primary signals contains within it the first requirements of the detector

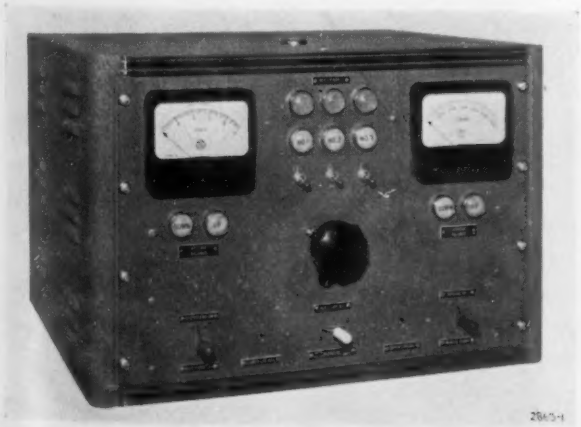


Fig. 30. Master control unit for large rectifier bank—automatic voltage and current stabilization.

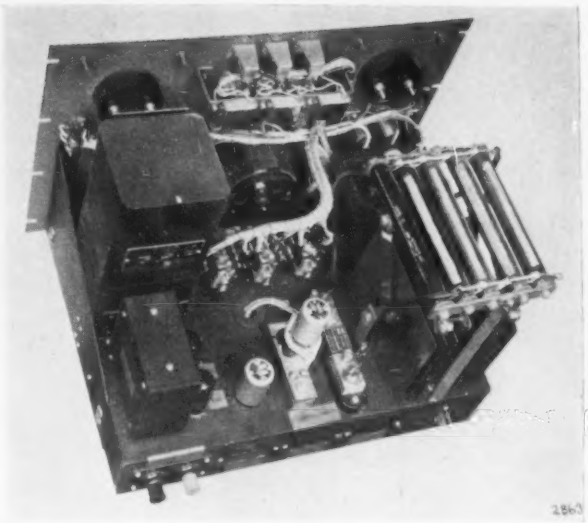


Fig. 31. Rear view of master control unit.

device—(1) it must respond to DC signals and must be capable of distinguishing between signals of opposite polarity, and (2) it must be inactive when the signal is absent, or in practical terms, close to zero.

The next requirement to be investigated is that of sensitivity—what is the order of magnitude of the signal potential to which the detector must respond?

In the case of low voltage rectifiers for electroplating, a desirable value would be of the order of 1% of a typical potential for electroplating. 1% of 6 volts would be .06 volt. Therefore, the detector should respond reliably to .06 volt, preferably slightly less—say, .05 volt. Excess sensitivity is generally to be avoided since this would simply result in incessant and needless operation of the equipment in correcting for negligible fluctuations in AC supply line voltage. Furthermore, the danger of "hunting" (overshoot and return of the motor-driven AC control) increases rapidly as the detector sensitivity is increased. Unless special precautions are taken, the theoretical limiting factors are the inertia of the motor drive and the minimum voltage increment (value per single step) available from the AC control, either of which will ultimately result in continuous hunting if the sensitivity is increased too far.

Experience has shown that a figure of "1% of maximum voltage rating of the rectifier" can be achieved readily, will not result in hunting, and produces a degree of voltage stability adequate for all normal plating processes.

Another requirement of the detector device which can easily be overlooked in a superficial analysis is that it must be capable of withstanding, without damage, the full maximum rectifier potential. It can be seen that under certain conditions—for instance, when the rectifier is first turned on—there may be a considerable difference between the values of the tank voltage and the reference voltage, and this may reach a value equal to the maximum rating of the rectifier unit.

This second requirement sharply limits the field of choice of suitable detectors to those devices which will not only respond positively to a potential as small as .05 volt, but will withstand the sudden application of as high as 6 volts without damage and without impairment of sensitivity. It was primarily this consideration which, in an early type of stabilizer, led to the choice of an electron tube amplifier (Fig. 28) as the input device. The tubes provided ample sensitivity and at the same time protected the final relay from damage simply by overloading when the input potential was much higher than the normal minimum signal voltage.

The voltage difference detector is seldom capable of direct control of the motor circuit and must be followed by a relay, or some other form of amplification which will open and close appropriate circuits to operate the reversible motor. The exact specifications for this auxiliary device derive directly from the type of detector utilized, but the final element must be a relay equipped with contacts adequate to handle the motor current.

To recapitulate: The sequence of operations in an automatic voltage stabilizer of the type shown in the block diagram, Fig. 27, is as follows:

(1) Between the AC power supply source and the rectifier transformer is a variable voltage control geared to a small reversible motor.

(2) Across the tank terminals (or across the rectifier terminals if busbar drop may be ignored) is bridged a network comprising a variable reference voltage and a detector responsive to small differences of potential and capable of distinguishing between positive and negative potentials.

(3) If the tank voltage differs from the desired voltage (set by the reference voltage control), the detector responds. This response is amplified and closes one circuit or another of the reversible motor.

(4) The motor drives the AC voltage control in the direction required to bring the DC tank voltage closer to the reference voltage. When the difference between these voltages is very small—i.e., less than the minimum signal to which the detector will respond—the motor current is cut off.

Automatic Current Stabilization—Theory

Excepting for one simple difference in circuit, an automatic current stabilizer is identical in principle with the automatic voltage stabilizer described above. The signal potential is derived, not from across the tank, but from across a standard ammeter shunt connected in series with the tank busbar. This may conveniently be the same shunt that is used to supply potential to the indicating ammeter.

This change, slight as it appears, enormously complicates the problems of developing a practical current stabilizer. In a typical voltage stabilizer, the maximum tank voltage would be about 6 volts and the detector must respond to about 1% of this—or .05 volt. In a current stabilizer, however, the maximum potential developed across a standard shunt at full rated amperes is only .05 volt and the detector device must respond to 1% of this—or .0005 volt! In other words, the detector device must be about one hundred times as sensitive as that used in a typical voltage stabilizer.

Although for electroplating operations stabilization to plus-minus 1% of maximum current rating is ample, other processes may require closer control. The 15 volt, 2,000 ampere unit shown in Fig. 29, for example, is stabilized to plus-minus one-quarter of 1%—or 5 amperes!

Stabilization of Rectifier Banks

Since the largest practical rectifier unit has a capacity in the neighborhood of 5,000 amperes (at 6 volts), it was necessary for higher current capacities to devise circuits to permit the simultaneous control of two or more rectifier units, each with its own motor-driven AC voltage control, from a master stabilizer unit. Since the rectifier units are parallel-connected, several interesting problems were introduced. For example, it was necessary to devise a means of automatically dividing the load more or less equally between the several rectifier units, particularly near the full load rating of the bank. Also, in case of automatic shutdown of one of the units, due to excessive temperature or other cause, it is necessary to protect the remaining units from the resulting possible overload.

These problems, and others, have been successfully solved, and Figs. 30 and 31 show a master stabilizer

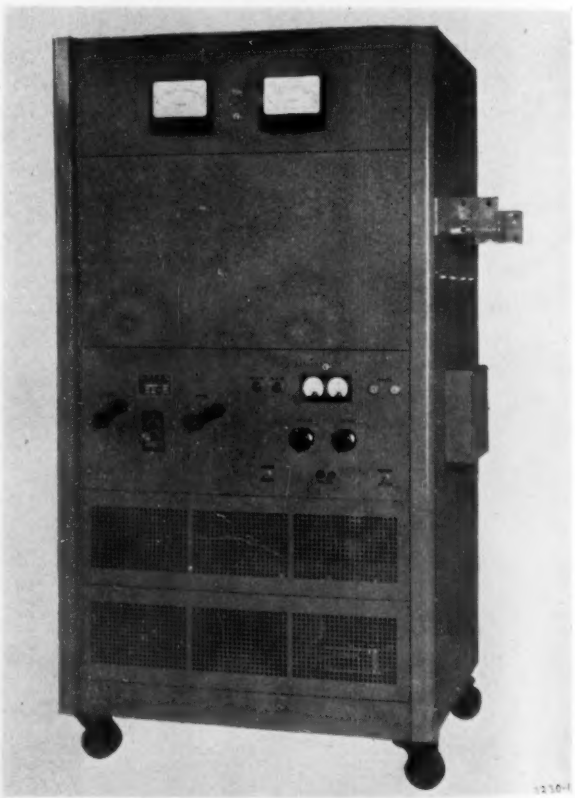


Fig. 29. 15 volt, 2000 ampere rectifier incorporating one-quarter percent automatic current stabilization.

control unit for three remote rectifiers with a total rating of 8 volts, 12000 amperes. This particular control unit provides, at will, a choice of automatic voltage stabilization over the range 4 to 8 volts, or automatic current stabilization up to 12000 amperes. Also, both types of stabilization may be cut out and plain (unstabilized) remote control substituted if preferred.

This latest type of stabilizer does not use heater type tubes. The two small tubes, visible in one of the photographs, are of the cold cathode type which have an exceedingly long life and require no warmup delay before use. The two tubes, and the associated relays, are of the plug-in type which simplifies any necessary replacement.

A minor refinement incorporated in this control is that, for light loads, one or two rectifiers may be selected for operation (note the three toggle switches) leaving the balance idle. This also facilitates operation at two-thirds load if it is desired to inspect or clean one of the rectifiers.

Practicability

The economic desirability of automatic stabilization for certain types of layouts was discussed in the beginning of this article. The only remaining question is the practicability of equipment to achieve this end.

Voltage stabilization of rectifiers has, for some applications, been practiced for over twenty years. Systems suitable for high current plating rectifiers, of the type described in this article, have been used for several years and have been successfully applied to equipment ranging from 300 amperes to 20000 amperes. Plating rectifiers with automatic voltage stabilization are offered, at the present writing, by at least three manufacturers, and automatic current stabilization is also offered by at least one of these three.

The equipment is available. The full utilization of stabilized power supply depends upon the ingenuity of the plating fraternity.

CLEANING SURFACES BY NON-EROSIVE BLASTING

(*Concluded from page* 56)

blasting operation. Of particular interest is the fact that no protective masking is required for the accurately machined surfaces that are exposed to the blast. Contrast this with Figure 5, showing the older method of using rubber plugs in the tapped holes and masking devices on other critical surfaces.

This shop customarily consumes about two 100-lb. bags of walnut shells per day. The grit is re-used over and over again. The carbon and oxide deposits removed by the blast are separated from the grit in the blow-off equipment. Likewise separated from particles of proper mesh is the shell that has been fractured to a powder. At the end of a week's operation about four 55-gal. barrels of waste is collected in the blow-off hopper.

American Airlines has come to the conclusion after periods of extensive testing and trials that seed blasting is the most thorough and economical method for cleaning airplane engine parts made of aluminum alloy. Solvent methods which allow for conveyorization have been tried, but this blasting method in connection with the preparatory dips remains as the fastest cleaning method for the removal of the tough, adherent carbon deposits. Compared with sandblasting, which was the previous practice, seed blasting has produced greater production at considerable saving of labor costs largely because the masking of critical surfaces to avoid abrasion is unnecessary.

Aiming for extra high production in the cleaning of airplane engines, the Army Air Forces have developed a conveyorized system which combines a solvent degreasing cycle with seed blasting. The solvent assures the removal of all oils and greases from the engine parts, which leave the degreaser dry and at a temperature of 188° F. The pistons then receive high pressure blasting with chopped dehydrated wheat of a particle size twice that of ordinary sand. This grit was found to be as long lasting as the sand, with the added advantage that no damage to the smoothly ground surfaces occurred.

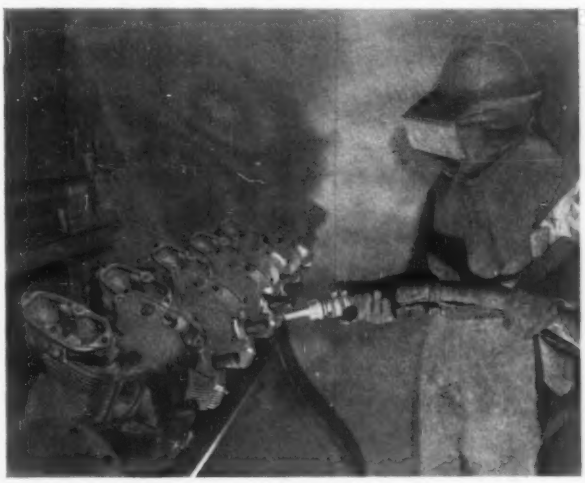


Fig. 5. Previous method of sandblasting required masking of threaded and polished areas by means of rubber plugs and gaskets.

It is expected that the application of this method of cleaning will find ever widening uses in the metal finishing field, in view of the unique results that can be achieved by proper choice of grits and operating techniques.

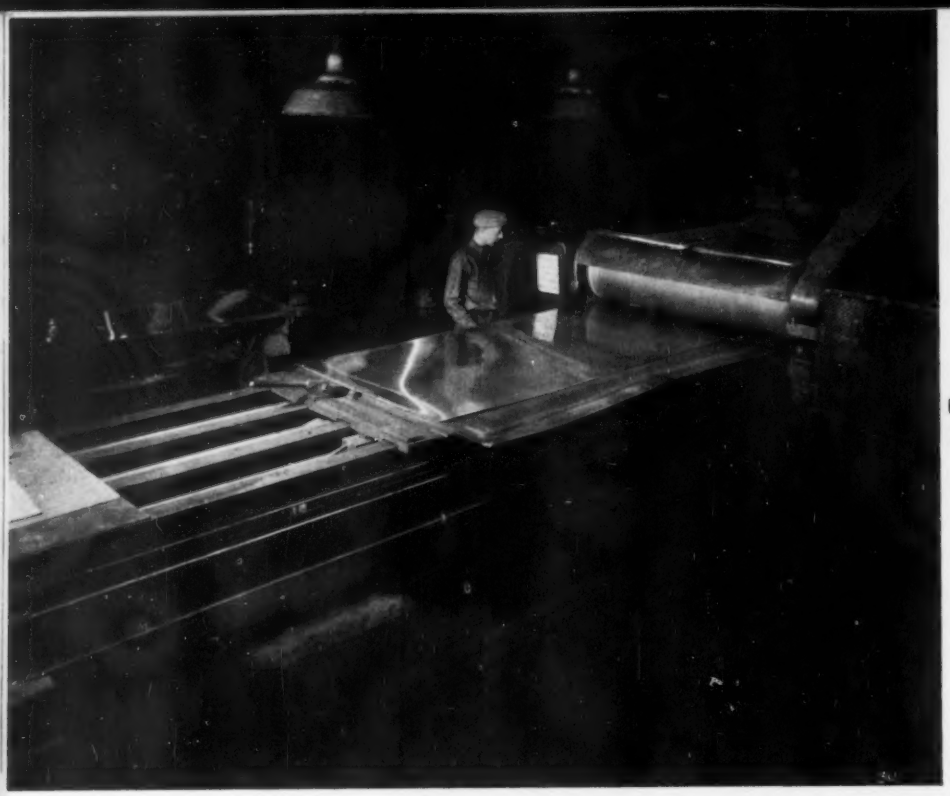


Figure 1. Polishing stainless steel sheet on automatic equipment.

(Courtesy Republic Steel Corp.)

Fabricating and Finishing Stainless Steel

Part III

By Arthur P. Schulze, *Lakewood 7, Ohio*

This part deals with grinding, polishing and buffing of stainless steel. A chart shows cycles to follow in mechanical surface finishing of stainless, which requires somewhat different techniques than that for other steels and nonferrous metals.—Ed.

THE technique of processing stainless steels to various more or less reflective surface finishes may be classified in terms of two general methods, mechanical and chemical. Comprising the first group of these finishing operations are grinding, polishing and buffing,[1] the triple topic of this condensed discussion. Review of chemical methods, electrolytic polishing, a comparatively new procedure of treating and finishing stainless steel surfaces, will follow in another paper.

The extent to which these mechanical surface finishing practices are utilized depends upon the application a given product or equipment is to serve. Some environments . . . high temperature, oxidation-resistance installations, for example . . . do not require them. Yet on the other hand, there are many applications where the highest degree of surface smoothness is essential, such as certain food processing and chemical equipment. When equipment is fabricated by welding, final surface preparation frequently includes removal of excess metal on welding beads.[2]

Thus, when sanitary conditions must be met and where the structure is welded, it is often necessary to grind and polish stainless steel.[3] Such refinishing is therefore divided into two classes: (1) grinding to remove rapidly any metal defects; (2) polishing to bring up a smooth surface with either a high or dull luster.[4]

Grinding

Grinding, polishing and buffing of stainless steel must be considered differently from other steels and nonferrous metals and alloys. The stainless steels are characterized by high strength, a property reflected through increased power requirements to remove material. Tougher than other steels, the stainless grades tend to "drag" or "burr," generating extreme heat and forming long stringy chips,[5] and wear out wheels more rapidly. Their ability to conduct heat away from the area being ground or polished is relatively low . . . slower than other steels and nonferrous metals . . . and, therefore, they are easier to overheat and warp. Along with this, in the case of the chrome-nickel alloys, is

the fact that the coefficient of expansion is quite high. All of which not only point to the need of guarding against burning and distortion but, in addition, underscore the basic fact that certain special precautions are required to prevent abusive practices. Otherwise, the conventional methods apply.[1,2,6]

Many factors must be considered in grinding stainless steels. Among the chief ones are these: (1) type of alloy used, which determines abrasive selection—silicon carbide for austenitic, ferritic and soft martensitic types, aluminum oxide for martensitic type in a hardened state; (2) kind of grinding—cylindrical, surfacing (horizontal or vertical spindles), internal, cutting-off, etc.; (3) amount of stock to be removed, accuracy and finish desired; (4) size of work; (5) size of wheel used; (6) type of grinding machine; (7) hardness; (8) grinding compound utilized and its consistency.[5] And to minimize the extent of finishing operations, it is advantageous first to select the proper sheet finish, keeping in mind such other fabricating operations as deep drawing, intermediate annealing, pickling and welding.[1]

For the removal of welding beads, grinding with wheels perhaps is the most common practice. However, heavy initial cuts are sometimes accomplished with cutting tools.[2] In this initial grinding, used where considerable metal is to be removed as is the case with grinding a weld flush or matching a welded area with the general surface of the product,[6] it is quite customary to use free-cutting hard rubber or bakelite bond wheels running at a surface speed of about 7000-8000 feet per minute.[3] A wheel of this type cuts faster, wears less and shows less loading or glazing than lower-speed wheels.[4] Grit in the wheel should be just as low in iron content as possible so as to eliminate or minimize any surface contamination from this element.[3,4]

If the original bead is fairly rough, it may be found desirable to start with a roughing operation, using a hard wheel containing an aluminum oxide grit of approximately No. 20-No. 24 size. For some applications, this may prove sufficient.[2] The weld should stand out in relief over and above the remaining surface. No grinding should be started, however, if the area next to the weld is concave because excessive grinding will be required and the finished job will be too thin in these places.[6]

When it is necessary to dress the bead down more than provided by the aforementioned treatment, a further step is often taken, using a No. 40 or No. 60 grit, or even finer. This second operation, recommended when the application involves finally matching up with a ground and polished sheet or plate surface,[2] should continue until the ground area appears to widen out, indicating that the level of the parent metal is reached.[6] Even better still, perhaps, where weld beads are to be ground down and finally dressed to match mill finishes on the material joined, is to finish the hard wheel grinding slightly above or barely over the finish level, so that the final matching treatment will not produce a groove along the bead. When care is exercised, this danger can be avoided, and as a further constructive aid in this direction, stops or limiting lugs can be attached to portable grinding machines on either side of the wheel to limit cutting to a predetermined point.[2]

Forcing the wheel by bearing down upon it is a temptation that must be avoided.[2] Only mild pressure should be applied so as to prevent discoloration and distortion from excessive heating.[1] Allowing the wheel to ride on the work so that the cutting edges of the individual grits may perform their assigned work at recommended speeds, constitutes most efficient operation. Remembering the characteristics of stainless steels, the desirability of moving along the bead being ground and not allowing the wheel to dwell at one spot becomes obvious. Localized heating may cause buckling and, in extreme cases, loss of corrosion resistance. If these alloys attain a temperature of approximately 400° F., heat-tinting may result.[2] A length of 12 to 18 inches should be ground at one time, moving the machine over the surface fast enough to keep from over-heating.[6]

Where the use of a lubricating composition for cooling appears desirable, it is advisable to consult the wheel manufacturer for his particular recommendations.[2] Lubricants of high-grade quality are commercially available from numerous sources of supply, but due to the wide variety of these products, it is equally important to follow in their application the special instructions or suggestions of manufacturers.[1]

Plant experience and shop practice commonly demonstrate that hard and brittle metals are best ground with fine size, soft aluminum oxide abrasive wheels, and the soft, stringy, tough alloys most efficiently ground with silicon carbide wheels. And in both cases, particularly in wet-grinding, use of the correct grinding compound is a factor of paramount importance. That point cannot be emphasized too strongly. The same may be said of the necessity for using a suitable treatment of the grinding wheel with special lubricants if grinding is performed dry. Generally speaking, the most desirable compound, most metal finishers have found, is one that provides good cutting, penetrating and detergent qualities. For effectiveness, this compound should be of about 40 to 1 or 50 to 1 consistency, and have the facility of lubricating and adhering to the grinding surface of the

(Courtesy Allegheny Ludlum Steel Corp.)

Figure 2. Polishing stainless sheet by means of belt type equipment.

grinding wheel. Its viscosity and chemical composition should effect good lubrication between the abrasive grain and the metal chips so that the chips do not stick to the grinding wheel.[5]

It is considered good practice on flat surface work to change the direction of grinding each time the grit size is changed. This may prove difficult with weld bead work, however, since it is by no means easy to hold the wheel on a relatively narrow bead when cross-grinding.[2]

Size and shape of the wheels depend upon the contour of the area to be ground.[6] Standard cylindrical wheels are generally used although on flat seams a cup-shaped wheel on a vertical shaft hand grinder has been found to give more satisfactory results with less tendency to gouge the adjoining surface.[3,4] With portable equipment, such as the manually-operated pneumatic and electrically-driven machines in widespread present-day use, lightness in weight of wheel also is a factor to be considered when selecting wheel diameters and widths.[2] As a rule, stationary wheels are of 12 to 14 inches diameter, whereas portable ones are about 4 to 8 inches in diameter with face widths to suit the particular product.[1]

In the application of successive abrasives, it is very important that the proper sequence be followed to prevent scratching and reconditioning the work.[1] Equally essential is the additional requirement that careful attention be paid to avoiding foreign materials on grinding wheels intended for use on both the chromium and straight chromium alloys. Contamination due to iron or other impurities may result,[2] as they may become impregnated on the surface and appear as a yellow or brownish discoloration against the bright stainless steel background upon exposure to the weather.[3,4,6]

Still another good rule well worth remembering is: keep wheels dressed up! Sharp corners or edges should be avoided; they may be dangerous if wheels are canted in operation. Maintenance of concentricity is important from the viewpoint of avoiding vibration. And to insure cleanliness of adjacent alloy surfaces during grinding, they should be protected with a coating of glued-on paper or other materials.[2]

Polishing

Polishing and buffing are surface-conditioning operations that follow grinding. Polishing has as its objective the development or production of surface finishes or appearances of smoother types against those obtainable through grinding. Buffing, which differs from polishing in that it is utilized to secure the higher lusters, involves the employment of extremely fine grits or buffing compounds that are applied as may be required during operation directly on the wheels or upon the work.

Thus, since they are used as surface conditioners, polishing and buffing of stainless steels should not be undertaken until all surface defects, imperfections or irregularities removable by grinding have been eliminated and a good clean base surface of uniform finish and appearance accordingly provided. Spot grinding may be used for removing these defects, but this preparatory operation must be carefully performed to avoid leaving depressions or grinding marks which

(Courtesy Republic Steel Corp.)

Figure 3. Hand coloring, or cleaning, stainless sheet with a soft flannel cloth and precipitated chalk.

cannot be obliterated by subsequent polishing with successively finer grits.[2]

In polishing operations a series of grit sizes are employed. An abrasive selected for the initial step influences in large measure the final operations and final finish, so the selection of this initial compound holds considerable importance;[8] it depends on the condition of the surface to be treated. Grit size should be chosen on the basis that through its use the operator will be able to remove pits, scratches or marks from any previous grinding or other operations.[2]

Scratching and reconditioning are side-stepped when successive abrasives are applied in their proper sequence. Greater efficiency and more economical operation is the rule when the first grain size is the appropriate one to successfully remove surface imperfections; the succeeding operation calling for the next size for removal of such marks and defects as may have been left by the preceding grain, then proceeding until the first buffing, for which a suitable stainless buffing composition is used.[8]

One initial selection frequently specified is No. 80, though in some instances No. 100 or finer grits have proved satisfactory. In any event, only through trial can the exact selection be correctly determined. This initial or rough-polishing operation should be continued until a good, clean, uniform, blemish-free surface texture is secured, one exhibiting no marks which the initial grit should remove.[2]

Wheels carrying successively finer grits are used following this until the desired finish is obtained or until the surface is ready for buffing. Changes in grit sizes are usually 40 numbers. After the initial No. 80 or No. 100 grit, the sequence might be No. 120 or No. 140, and then No. 160 or No. 180.[2] In short, the sequence of operations in any given instance depends on the condition of the surface as it comes to the finishing operation. Deep die-marks, or scratches necessitate polishing. Otherwise, the question of whether or not to polish before buffing is largely a matter of comparative total cost which must be determined for each plant and each job, as a rule.[9]

Best results have been obtained in many cases starting with No. 80 grit dry and following with No. 100

and No. 120, with polishing grease on the surface.[3] Frequently, No. 120 has proved quite satisfactory for the finished job.[4] Beginning with No. 120 or No. 140 abrasive sizes, use of lubricants such as mutton tallow and stearic acid may prove desirable. It is helpful to change the direction of polishing with each change of grit size so as to better eliminate the marks remaining from the previously employed grit.[2] Polishing speeds vary with the class of work being performed,[2] ranging from 5000[1, 3, 4, 6] to 8000[1] or even 9000[2] surface feet per minute.

Because, as previously indicated, stainless steels are tougher to finish by mechanical methods than ordinary steels or nonferrous metals, the set-up wheel should be prepared very carefully.[6] Proper preparation is vitally essential; and this includes selection of materials from which the wheels are made and exercise of proper precautions in their making-up.[2]

After wheels are trued up, they are ready for the application of abrasives, which should be screened carefully for uniformity of size and applied to the wheel with glue. With the service conditions under which this adhesive must function being extremely severe from the standpoints of temperature, shock and strength of adhesive bond, a good grade of glue should be selected. In its application to the wheel, methods should be used that will result in the tightest possible bond to the cloth of the wheel as well as maximum holding power on the adhesive.[2]

One widely used procedure[6] covering glue treatment and proper glue-and-water ration for various grits, is presented in condensed form as follows:

Selection: Use of good grade animal hide glue is a "must." Bone glue, fish glue and cold glue, varied plant experience has demonstrated, prove inefficient by comparison. Commercial cements are being successfully employed without heating.

Mixing: Mix glue by weight only. Never heat more than three-hour supply at one time. To meet average polishing room conditions, this table of mixtures will serve as a good guide for setting up wheels:

Size of Grain	% Glue	% Water
24-36	50	50
46-54	45	55
60-70	40	60
80-90	35	65
100-120	33	67
150-180	30	70
220-240	25	75

Soaking: This allows glue to dissolve more readily upon heating. Use pure cold water and soak:

Ground glue .....One hour or more.
Flake glue .....Six hours or more.
Cake glue .....Twelve hours or more.

Melting Glue: The glue should be melted in a water-jacketed kettle. When wheels and glue are preheated, apply glue at temperature of 140° F. With wheels and grain at room temperature, use glue at 160° F. Keep a thermometer in the glue pot as a constant check, even though thermostatically-regulated glue pot is used. All equipment used should always be kept clean.

Made-up wheels, which carry either aluminum oxide or silicon carbide abrasive depending on individual conditions, consist of layers or sections of circular cloth (usually unbleached muslin) disc. Each layer comprises several individual discs assembled on a common center and sewn together. Sewing is done in line with accepted designs or patterns so that stiffness near the center and flexibility toward the edge are secured.[2] In building up the wheel, these separate layers are then assembled on a common center to the desired thickness. Between each two or so sections of sewed buffs are often inserted paper discs or cardboard spacers to increase softness or cushioning as well as to provide wheel ventilation.[2, 6]

The precautions cited earlier regarding grinding are equally applicable to polishing, namely, avoidance of iron or other contaminates in both abrasives and lubricants to prevent surface discoloration, care of wheels when not in use, their restriction to use on stainless steels only, avoidance of undue pressure on wheels while performing the actual polishing operation to prevent discoloration and distortion resulting from excessive heating, their operation at proper speeds, and avoidance of heat build-up due to dwelling on one spot.[1, 2]

Buffing

For buffing, softer wheels are employed. The sewing of the cloth discs into sections is less in extent than on polishing wheels. Since it is confined to a zone much closer to the center, the result is greatly increased flexibility or softness out near the periphery. In some instances, sewing is omitted entirely on wheels used for final finishing. As in the case of polishing, ventilation of wheels may be provided with the insertion of cardboard spacers. In buffing, too, care should be taken to prevent excessive heat generation.[2]

In buffing operations, high peripheral speeds are imperative for most economical results.[9] They are higher than for polishing.[2] Grinding and polishing (cutting) speeds vary usually from 5000 to 8000 S.F.P.M., while buffing (coloring) speeds range from 8000 to 12,000 S.F.P.M.[1]

The initial step in buffing normally comprises dressing or cutting with very fine abrasive and lubricant made up in the form of a buffing compound. For the second and final step, a green chromic oxide preparation used in conjunction with a clean wheel produces a very high luster.[2] Turkish emery is frequently used in the finer grit sizes,[2] but is not recommended as a last finishing operation on stainless, because of the possibility of iron contamination which will result in discoloration of the stainless.[6]

Castings that are to be polished should be thoroughly cleaned and sandblasted, then ground with a hard wheel to remove pits or other surface irregularities. They may then be polished with a No. 60 grit, followed by No. 120, and finally with a No. 150 grit glued on to a canvas wheel, surface of which may be rubbed with a grease. This may be followed,

GRINDING, POLISHING AND BUFFING CHART

Name of Operation	No. of Operation	Grit	Manf. Abrasive	Turkish Emery	Wheels	Dry	Grease	Compound	Approx. S.F.P.M.	Finish
Grinding	1	No. 36 No. 60	X		Rubber or Bakelite Bond	X			7,000-8,000	
Roughing	2	No. 80	X		Soft Cotton Fabric, Sewed-Sections or Quick-As-Wink Wheels	X			7,000-8,000	Rough Ground
Greasing	3	No. 100	X		Ditto		X	Polishing Tallow	7,000-8,000	Grease Finish
Greasing	4	No. 120 or No. 150	X		Ditto		X	Polishing Tallow	7,000-8,000	No. 4 Finish and Base for No. 6
Greasing	5	No. 180	X or	X	Ditto		X	Polishing Tallow	7,000-8,000	Base for No. 7
Greasing	6	No. 220 or No. 240	X or	X	Ditto		X	Polishing Tallow	7,000-8,000	Base for No. 8
Cutting-Buff	7				Bias or Pocket			Aluminous Oxide Buffing Compound	10,000 Min.	No. 8
Color Buff	8				Loose Disc or Canton Flannel Buff			Ditto—For coloring only	9,000 Max.	No. 8
Tampico	9				Tampico Brush			Powdered Pumice, Kerosene, Oil	5,000 Max.	No. 6
Special	10				Bias or Pocket Buff			Lea Compound Grade E	5,000 Max.	Butler
Special	11				Stainless Steel Brush			Stainless Wire Brush	5,000 Max.	Wire Brush
Cleaning	12				Canton Flannel Cloth—Hand Operation			Whiting or Precipitated Chalk		

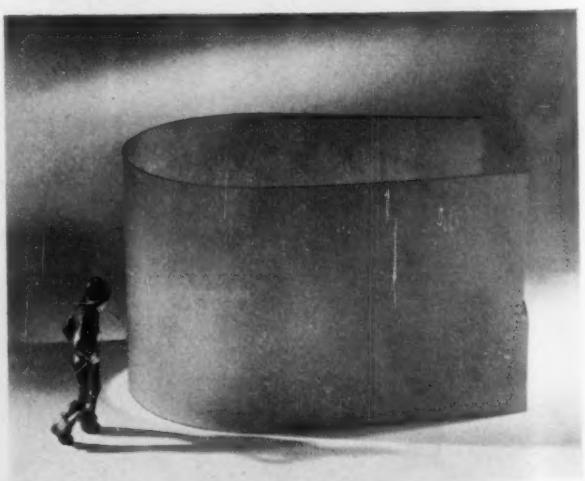
if desired, by buffing with one of the standard commercially available buffing compounds.[2]

Summary

From the foregoing discussion it is clear that a great number of variables directly or indirectly affect the mechanical surface finishing of stainless steels. Yet, despite this, it may be safely said with solidly established certainty that with proper technique, as accumulated experience of many plants and shops plainly reveals, all the stainless steels excepting the stabilized (titanium and columbium bearing grades) may be finished mechanically to a wide variety of surface conditions ranging from a ground finish to a deep beautiful luster to suit diversified specific requirements.[1]

So in concluding our review of this topic, it might be well in view of this observation to present some sort of a general guide indicating not only the proper finishing cycle required to produce a mirror finish from a welded condition . . . the two extremes of surface finish . . . but also the proper procedure to produce commercial or special finishes on sheet and strip products. It is with this purpose in mind that the accompanying chart * is reproduced here.[6] Such a guide will thus prove helpful to fabricators confronted by the problem of matching up welded or other areas with machine finishes on plates, sheets or bars as received from producing mills.

In this connection, to make this data complete, the



(Courtesy Eastern Stainless Steel Corp.)

Figure 4. No. 1 Finish; representing a pickled surface which is not reflective but is bright and dense.

* Courtesy Republic Steel Corporation, Alloy Steel Division, Massillon, O.

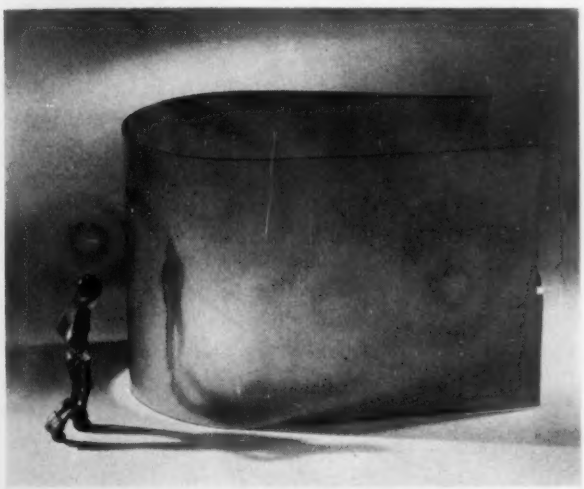
following supplementary explanations and observations are presented.[6]

Operation No. 1: Used where considerable metal is to be removed. Flexible shafts or portable tools are highly satisfactory for this job.

Operation No. 2: Following No. 1 in preparing a welded area to a No. 4 finish or used as initial step in producing No. 4 finish from heavy gauge sheets or plates, Operation No. 2 should continue until all heavy grit lines are eliminated when following Operation No. 1. In the case of grinding heavy gauge sheets or plates, it should continue until all surface imperfections are removed.

Operation No. 3: Follows No. 2 in any case. Also used as an initial operation for light gauge sheets. Performed with grease stick or oil to lubricate wheel and bring up color. Continues until all grit lines are removed from Operation No. 2, or in the case of polishing light gauge sheets, until uniform polish is obtained.

Operation No. 4: Relatively short operation; used just long enough to develop uniform finish such as standard accepted No. 4 finish. *Note:* This cycle



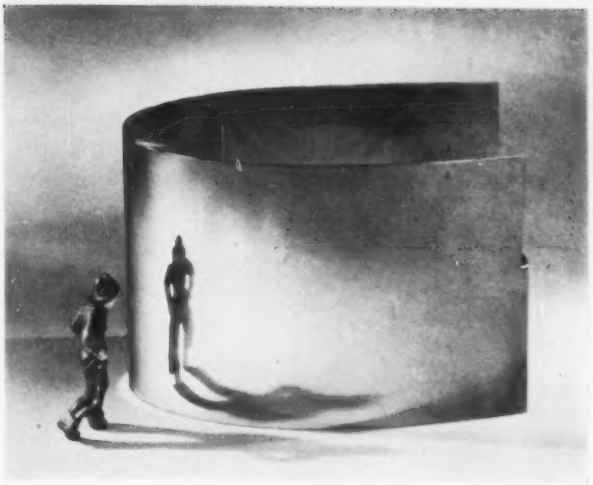
(Courtesy Eastern Stainless Steel Corp.)

Figure 5. No. 2B Finish; mildly reflective, dense, bright and lustrous.

should suffice as the greatest percentage of polished stainless is used in No. 4 finish. However, since virtually all polishing wheels and equipment employed by fabricators are not sufficiently wide to cover entire area of finished product, grease streaks or highlights will show up after Operation No. 4. Entire area can then be blended into uniform No. 4 finish by using No. 150 or No. 180 abrasive cloth, soaked in oil, on hand block and lightly rubbing surface.

Operation No. 5: Follows No. 4 when No. 7 or high luster finish is desired, continuing long enough to remove any heavy grit lines from Operation No. 4 which are not perceptible in the No. 4 finish but show up in the buffing operation necessary to produce No. 7 or high luster finish.

Operation No. 6: Should continue long enough to remove *all* grit lines and develop considerable reflectivity.



(Courtesy Eastern Stainless Steel Corp.)

Figure 6. No. 4 Finish; highly reflective and possessing a silvery appearance.

Operation No. 7: Should continue long enough to bring up mirror finish.

Operation No. 8: Relatively short operation after No. 7; necessary only to bring out ultimate color and reflectivity.

Operation No. 9: Used after Operation No. 4 to develop No. 6 or Tampico finish.

Operation No. 10: Used after Operation No. 4 to develop butler finish.

Operation No. 11: Used after Operation No. 4 to develop wire brush finish.

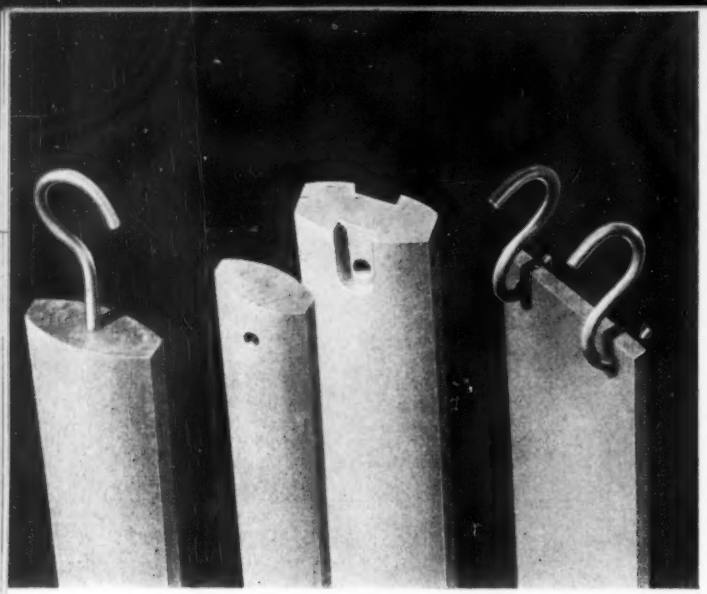
Operation No. 12: Cleaning operation required to remove film of grease from any grease wheel. This is a finishing operation after buffing operation.

To develop a standard No. 4 finish on highly cold rolled sheets and strips to be polished in the flat, only Operation No. 3 followed by No. 4 is required. To produce a finish on formed articles from sheet and strip such as that used on utensils and store fronts, polishing with Operation No. 4 followed by No. 5 comprises the surfacing cycle. However, in several cases, as with utensils, for instance, annealing the formed parts during fabrication is essential. Necessary polishing sequence after annealing and drawing operations largely depends on condition of drawn parts as they come out of the dies or after scale is removed. In most instances, grease grinding, such as Operations Nos. 3 and 4, is all that is required.[6]

On work spun entirely to shape, it is necessary oftentimes to utilize an operation such as No. 2 so as to eliminate tool marks. Various finishes other than those mentioned above can be produced with fine dry grits or abrasive cloth. Continuous buffing requires the fundamentals of No. 7 and No. 8.

In any polishing or buffing operation, oscillation of work proves decidedly helpful. In the case of continuous buffing, the buffs should be set at an angle. The last buff or finishing operation must be in a straight line; the last finishing pass must be made in the direction of wheel rotation.

(References appear on page 75)



(Courtesy American Brass Co.)

Anodes—Part I

By E. R. Thews, *London, England*

In this, the first of a series of articles on anodes, the various factors affecting the operation and properties of electroplating anodes is discussed, with special emphasis on copper and brass anodes. Subsequent articles will cover gold, zinc, cadmium, lead, tin, chromium, and nickel.—Ed.

ELECTROLYTIC anodes are able to fulfill their two main tasks, i.e., to serve as a current conductor into the electrolytes and to maintain the necessary metal content of the electrolyte as uniformly as possible, only if their chemical and physical properties are perfectly adapted to all prevailing requirements. The most important factors determining the usefulness of the anodes can be defined as follows:

1. The degree of purity of the anodes (referring mainly to undesirable impurities, since useful additions of other substances are frequently made to obtain certain improvements).
2. The physical state of the anodes (i.e., cast, rolled, hammered, sintered, electrolytically produced, etc.).
3. The shape of the anodes (i.e., plates of rectangular, elliptic cross-sections, lenticular-anodes thickened at the base, with smooth, grooved, sieve- or lattice-shaped surfaces, stick or billet-shaped anodes, cross-sections of practically every kind, and anodes whose shapes correspond to those of the cathode surfaces, etc.).
4. The degree of solubility of the anodes within the electrolytes under prevailing operating conditions.
5. The degree and type of detrimental changes accompanying the process of solution (formation of slimes, incrustations, passivity, etc.).

Anode Characteristics

The composition of the anodes, their physical state and all the other factors characteristic of the anodes used are selected for the main purpose of determining the degree of solubility of the anode material in the electrolyte under the operating conditions in question, including the composition and temperature of the electrolyte, anodic current densities, etc., and to avoid as far as possible all detrimental influences leading to the gradual neutralization of the anodes by the formation of adhering slimes, crusts, etc., as well as by polarization phenomena inducing passivity of the anodes. Chemical polarization can be caused by detrimental changes of the anode materials themselves (such as decomposition phenomena), while galvanic polarization is due to the formation of galvanic elements between the original anode material and certain products formed at the surface of the anodes, leading to the formation of counter-voltages and, as a consequence, to strong reductions of the voltages required in the electrolyte.

Degree of Solubility

This is influenced to a high degree by the shape of the anodes. The larger the surfaces of the anodes the more pronounced is their solubility under the operating conditions involved. Where anodes of smooth surface are not dissolved quickly enough under the existing galvanic operating conditions the surfaces may be enlarged by grooving or any other surface changes calculated to increase the surface area as much as possible without changing the general size of the anodes beyond that required for the purpose. Roughening of the anode surfaces by sand blasting, provision of holes and perforations, etc., are other possible ways of increasing the degree of solubility of the anodes. Where, on the other hand, the anodes exhibit too high a degree of solubility for the purposes in question, the usual method is to suspend insoluble anodes in the electrolyte, in sufficient number to reduce the active anode area to the value ensuring a proper amount of metal in the electrolyte without disturbing the anode/cathode area ratio.

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Cast Anodes

The degree of solubility of the anodes is most strongly influenced by their physical state. Cast anodes, for instance, are more easily soluble than rolled anodes, a fact chiefly due to the higher degree of smoothness and density of the surfaces, and to the dense and fine-grained structure of the rolled anodes. The degree of solubility of the cast anodes, however, is governed to a large extent by the casting conditions employed, which determine the structural characteristics of the anodes. The more coarsely crystalline the structure of cast anodes the more pronounced is their degree of solubility. Other factors involved in connection with alloyed anodes (e.g., bronze, brass and nickel-silver anodes) and with anodes containing small percentages of other substances are the intercrystalline forces and substances which are usually more soluble than the crystals themselves. The excessive wear of such coarse crystalline cast anodes is due in the first place to the fact that they are not uniformly dissolved, the intercrystalline substance being dissolved relatively quickly, loosening the degree of adhesion among the crystals which gradually drop out, mixing with the slimes at the bottom of the vats.

A typical example of this type of destruction are brass anodes which are not quickly cooled directly after casting, exhibiting a rather dense surface structure with a gradually coarsening structure toward the interior. Anodes of this type always work satisfactorily at first. As soon as the surface structure is worn away by electrolytic solution, however, the central portions of the anodes are quickly dissolved; the final result usually being a completely dense frame structure of solid metal, while the central section is partially or completely dissolved, the floor of the vat beneath the anodes being covered with crystals.

It is impossible within the scope of this article to offer detailed specifications as to the casting methods employed with the various types of anodes. Casting must always be carried out so that a uniform, fine-grained structure is obtained. Suitable heat-treatments of cast anodes frequently ensure considerable improvements of the cast structure. In view of the fact that even the most carefully controlled casting processes and thermic treatments are unable to influence the structure of the anodes beyond a certain wall thickness, the latter rarely exceeds 2 in. to 3 in., while a wall thickness of 4 in. must be considered an absolute maximum for practically all purposes.

On account of their high degree of solubility, cast anodes are usually employed only in connection with electrolytes of limited solvent power (under the electrolytic conditions selected), while electrolytes of comparatively high solvent capacities require the use of less soluble anodes of the rolled or forged types—or of a mixed set of anodes including the easily soluble cast anodes on one side and rolled or insoluble anodes on the other.

Insoluble Anodes

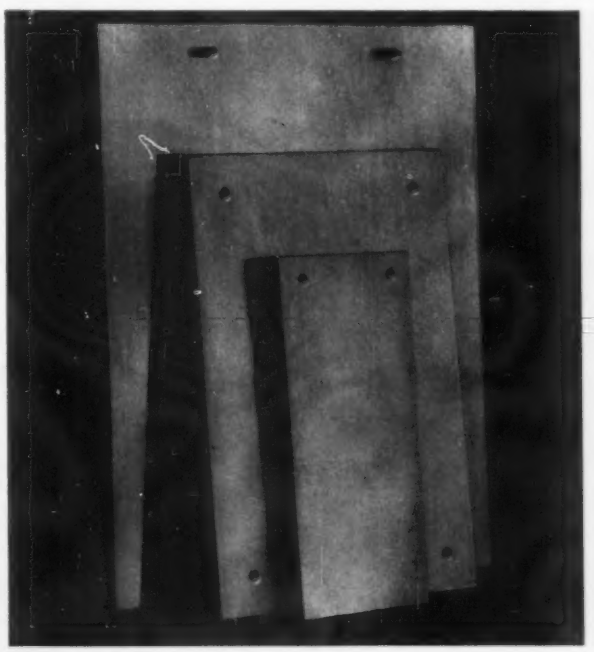
Where, for certain local reasons, cast anodes are selected in connection with electrolytes of high solvent capacities, insoluble anodes are indicated. These anodes of suitable size and shape are distributed among the active anodes in such a manner as to ensure most satisfactory electrolytic conditions. Wherever possible, a small insoluble anode is suspended on either side of the active cast anode, preventing excessive solution of the edges of the active anodes and prolonging their life accordingly.

Another characteristic of electrolytic action is that the degree of solubility of anodes increases toward the bottom. It is frequently found advisable, for this reason, to use anodes tapering somewhat from the bottom upward, prolonging their life accordingly and reducing the amount of anode scrap in proportion. This problem has also been tackled in a number of other ways. Some anodes are provided with suspension eyes or lugs at top and bottom. These anodes are turned upside down at regular intervals, ensuring uniform solution under most operating conditions. Excessive anode scrap is also prevented by the use of lenticular or spherical anode shapes arranged on insoluble anode rods, etc.

Since in accordance with the above deductions the degree of solubility of anodes increases with the coarseness of structure, considerable improvements can be achieved by hammering the cast structures. The degree of density and of general improvements attained by this treatment naturally depends on the type, composition, shape and thickness of the cast anodes.

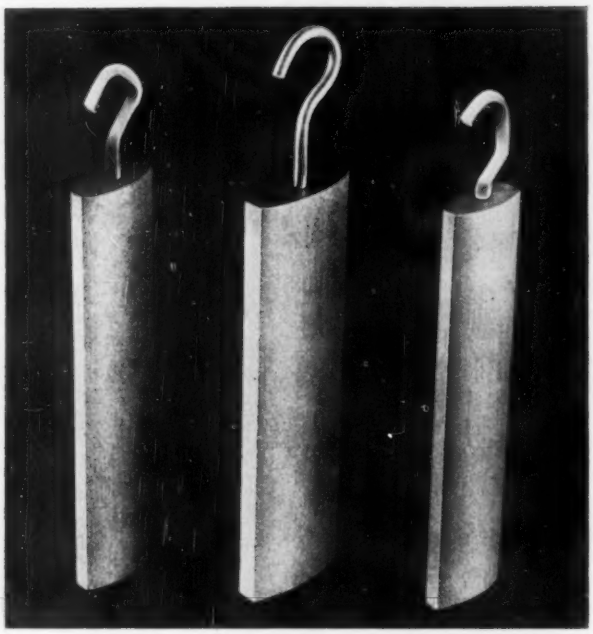
Hammered anodes thus represent an intermediate product between cast and rolled types of anodes, and have proved very valuable for numerous purposes involving their exclusive use or in connection with cast or rolled anodes.

Another type of anode intermediate between cast and rolled anodes, as far as the degree of solubility is concerned, are the electrolytically produced anodes. An advantage of these anodes is their high degree of purity, but this is accompanied by a tendency to scale



(Courtesy American Brass Co.)

Fig. 1. Rolled sheet copper anodes. Both hot and cold rolled types are used.



(Courtesy American Brass Co.)

Fig. 2. Rolled oval copper anodes. Brass and Bronze are also widely used in this shape.

off, a considerable amount of this scaling dropping into the anode slimes. These anodes are usually produced in form of plates or sheets or of other square shapes. Wherever a higher degree of solubility is required they are also made in form of lattice anodes of suitable shape.

Shape of Anodes

A very important factor in the plating of numerous special profiles of comparatively large diameter is the shape of the anodes. This must be adapted as much as possible to that of the articles to be plated in order to avoid excessive differences of distance between the various anode and cathode sections. The degree of conformity required depends on the throwing power of the system in question and on the size of the cathode surfaces. Rolled anodes are usually employed for this purpose. Where the differences of shape are too pronounced, as, for instance, in the case of deep recesses in the cathode surfaces, auxiliary anodes, usually consisting of pipe sections of suitable shape or of small strips of sheet material bent to proper shape are employed to advantage.

Difficulties, especially with regard to the solution of the anodes, are frequently encountered with alloyed anodes for brass or bronze plating, etc. It is often impossible to regulate the composition of the anodic alloys and of the electrolytes so as to obtain the cathodic alloying ratios desired. The composition of the electrolytes required for this purpose may then be regulated by adapting the entire electrolytic system to the metal constituent most easily dissolved and transported to the cathode, while the lack of the other alloying constituents is made up by the addition of corresponding quantities of suitable metallic salts to the electrolytes.

Slimes

Another problem to be mentioned in this connection is the formation of slimes produced by the decomposition of the anodes (governed by the character of the anodes and electrolytes) and/or by the chemical and galvanic transformation of anode material or metallic salts in the electrolyte. The more refined the grain and the higher the degree of density and purity of the anodes the smaller is the amount of slimes produced. Part of this slime drops to the bottom of the vats, while other portions remain afloat in the electrolyte. A large proportion of these finely divided particles are carried to the cathode by the electric current and, in stirred electrolytes, by the movement of the electrolytes, inducing the formation of impure and rough platings of comparatively low corrosion resistance. A third portion of the anodic slimes produced remains attached to the anodic surfaces, where they accumulate in a slimy, crusty state leading to unfavorable changes of electric current values and, finally, to complete passivity of the anodes. Regular cleaning of the anodes is therefore one of the most important prerequisites of successful electrolytic operation. In order to prevent excessive contamination of the electrolytes with anodic slimes, the anodes are frequently sewed into bags made of muslin, linen, wool or raw silk wherever the chemical properties of the electrolytes (for instance, the strongly acid solutions) do not render this expedient impossible.

It is sometimes possible, however, to circumvent excessive slime formation by suitable changes of anodes or electrolytes. This applies particularly to some alloyed anodes, such as bronze anodes, where suitable changes of the alloying ratios or of the heat-treatment of the anodes frequently lead to a considerable reduction of slime formation. This point will be considered in more detail in connection with the discussion of the various types of anodes.

Mention should also be made of the insoluble type of anodes which are frequently used together with the active anodes to reduce the amount of metal dissolved from the anodes at the current densities required without influencing the important electrolytic values involved. In many other cases where these insoluble anodes are employed alone, mostly for economic reasons, the metal content of the electrolytes is maintained by regular additions of suitable metallic salts. Insoluble anodes of this type are made of graphite or amorphous coal, lead or lead alloys containing tin or antimony, and certain iron alloys such as iron-nickel-chromium alloys and silicon-iron.

COPPER ANODES

The choice of copper anodes is governed in the first place by the type of copper electrolyte employed, since the general characteristics of the cyanide electrolytes naturally differ considerably from those exhibited by acid baths. This does not apply to the degree of purity specified, as maximum purity of the anodes is a prerequisite of successful copper plating from both types of electrolyte. The chief differences involved are the structural conditions of the anodes and the mechanical treatments accorded, i.e., whether the anodes

are cast, rolled, hammered, extruded or produced by electrolytic deposition.

No definite agreement appears to have been reached as yet as to the suitability of the various types of copper anodes for the different electrolytes—a fact doubtlessly due to the great variety of conditions prevailing in electrodeposition plants all over the world. It is an established fact, however, that rolled anodes made of pure electrolytic copper yield best results in cyanide and acid copper electrolytes, while cast copper anodes are better suited for cyanide electrolytes than for acid copper baths. It is also a matter of general agreement that only electrolytic copper should be used for all types of copper anodes irrespective of their final state of employment. The cast anodes are made by melting and pouring electrolytic copper, while the rolled anodes are produced either by direct rolling of copper cathodes (without an intermediate thermal treatment) or of bars or plates cast from electrolytic copper, while the straight electrolytic anodes are employed in their original state without thermal or mechanical intermediate treatment.

Cast Copper Anodes

The manufacture of these corresponds to the customary principles underlying modern copper casting practice. Electrolytic copper must be used exclusively, and the castings must exhibit a fine-grained uniform structure. Cuprous oxide must not be present even in smallest percentages, but this condition is easily fulfilled by the addition of a judicious amount of phosphor copper to the melt a few minutes previous to pouring. Maximum density of the cast anodes can be attained only if the fused metal is protected against the absorption of gases. It is necessary for this purpose to melt down the copper as quickly as possible and to keep the crucible tightly closed against the entrance of firing gases. In order to ensure maximum melting speed it is advisable not to fill the entire melting space at once but to melt down and superheat about 50 to 75 lbs. of metal as quickly as possible, and to add the rest so as to permit it to sink down into the bath and fuse within a minimum of time. The larger the bath thus formed the greater are the amounts of fresh copper added, best results being obtained if the copper is preheated to 316° to 370° C before charging into the crucible. Attention must be paid to the fact that all copper cathodes contain a small percentage of hydrogen which remains dissolved in the fused metal but separates on cooling. This hydrogen is removed from the metal by the addition of a small quantity of cupric oxide (1 oz./100 lb.) to the melt. The oxide is stirred in and permitted to react for one or two minutes. About 5-8 oz. of phosphor copper per 100 lb. of metal are then stirred into the metal. Casting takes place three minutes after adding the phosphor copper. Phosphor copper can only be effective if it has had sufficient time to react with all the oxide in the melt. If the copper is poured too quickly after adding the phosphor copper, the metal will not only contain oxide but phosphorus and phosphorus-oxide products as well, which, apart from contaminating the electrolytic system, will induce non-uniform solution of the anodes.

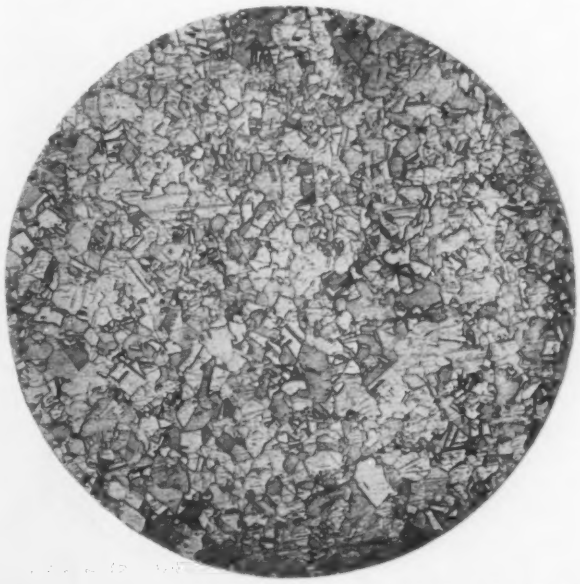
The pouring temperatures depend on the weight and shape of the anodes produced. Medium-sized anodes require a pouring temperature of 1,204° to 1,260° C.

A fine-grained, close structure of the cast copper anodes can be obtained only if the hot metal in the mould is forced to freeze as quickly as possible. Slow cooling induces the formation of coarsely crystalline structures leading to non-uniform solution of the anode substance by the electric current. Part of the large crystals are dissolved or separated by electrochemical activity along the crystal borders, much of the anode material being lost in the anode slimes.

This reaction takes place with particular speed and energy if any appreciable amount of cuprous oxide remains in the copper, the oxidized substances formed being deposited in an intercrystalline state. They are

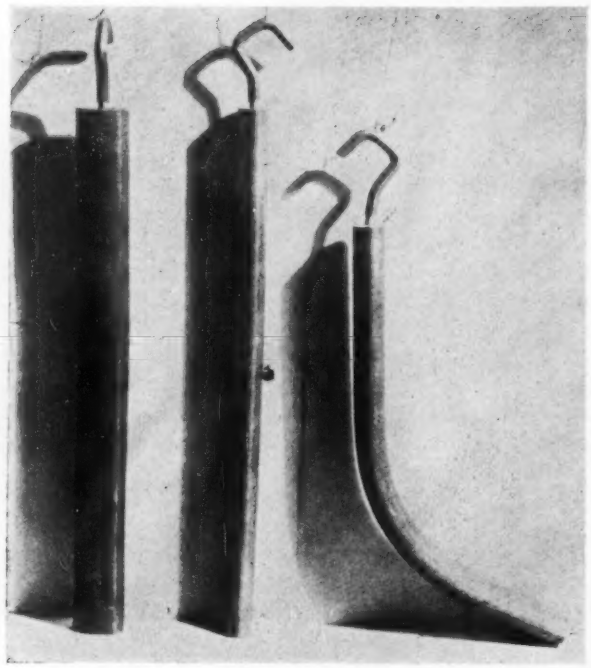
(Courtesy American Brass Co.)

Fig. 3. Elongated crystalline structure of electrolytic anode. Magnified 75x.



(Courtesy American Brass Co.)

Fig. 4. Equi-axed crystalline structure of a hot rolled anode.



(Courtesy Hanson-Van Winkle-Munning Co.)

Fig. 5. Cast brass anodes, elliptical cross section. Curved types widely used in barrel plating.

much more soluble under the operating conditions involved than the pure copper material, making up the crystals themselves, so that the crystals are gradually loosened and separated from one another before they have had time to be dissolved themselves.

Rolled Copper Anodes

This process considerably improves the properties. The density of the structure is increased and the grain-size refined, ensuring a much more uniform solution of surface copper from the anodes under usual operating conditions. It is important that the rolling pressures are as strong as possible and that the intermediate annealing and pickling treatments are carried out with due care. Particular attention must be paid to the pickling treatments in order to prevent oxides and scale being rolled into the anodic surfaces, causing non-uniform solution and decomposition of the anodes and, thereby, the production of rough copper deposits.

Straight Electrolytic Anodes

The use of this type of anode in its original unrolled state often leads to the production of brittle and/or rough copper deposits. The latter are usually due to powdery products of decomposition at the anodes, part of which are transported over to the cathodes by electrolytic or physical action. Smooth and dense anode surfaces free from bud or tree formation do not tend to powder as much as rough surfaces. Differences of purity of electrolytic copper anodes within the extremely narrow range of impurities possible in these products are without influence on the process or on the quality of the copper plating. Bud or tree formation on copper anodes is not due to powdery accretions or to other surface faults, but to excessive current densities in the electrolytic production of these anodes.

Rolling of the straight electrolytic anodes does not materially improve these conditions, even if the surfaces are ground smooth previous to rolling as is sometimes suggested. Costly surface treatments of this kind render the entire process uneconomic. Wherever original electrolytic anodes do not yield satisfactory results, even with special additions to the electrolytes, such as alcohol to acid sulphate electrolytes, they should not be used at all.

Extruded Anodes

A comparatively new type of copper anode equalling the rolled anodes as far as structural characteristics and general electrical properties are concerned and offering a much more economic adaptation of sizes and shapes to the copper-plated articles are the pressed, or extruded, anodes. These anodes are extruded like tubing or rods in hydraulic presses. These extruded shapes require no finishing treatment apart from the removal of fins or burrs. They can be extruded in practically every standard length and are then cut to size in accordance with specific requirements. The containers of these extrusion presses are usually dimensioned for ingots of from 100 to 550 lbs. in weight. These presses can also be used for the extrusion of brass or bronze anodes by changing the hydraulic pressures in accordance with the specific properties of these alloys.

The ratios of anode to cathode areas have been determined by a number of approximate fundamental rules. In acid copper electrolytes the anode area is about equal to the cathode area, while in cyanide electrolytes the anode areas must be considerably larger, i.e., about twice that of the cathode. If the anode area is not large enough, the anode surfaces (in cyanide electrolytes) are gradually covered with a dense and tenacious green slime. If this is brushed off, formation of fresh slimes commences at once, but it can be avoided almost completely—in most instances—by increasing the anode area or reducing the current densities, depending on the general electrolytic requirements of the process.

A very important problem is the tendency of the copper anodes to develop anodic polarization if the current densities exceed a certain critical value. This critical anodic current density is considerably lower in cyanide baths. Graham and Read have observed polarization phenomena at copper anodes under certain conditions at the comparatively low current densities of 20-30 amp./ft.^{2} The problem of reduction or elimination of these polarization phenomena has therefore been the object of numerous investigations and publications. It has been found, for instance, that if the total anode area is increased to twice the cathode area and if a small percentage of the anode area consists of insoluble anodes, such as iron anodes, polarization of copper anodes can be largely suppressed. With comparatively low metal contents of the electrolyte this percentage of the iron anodes need not amount to more than 5 per cent, while increasing quantities of metallic salts in the electrolytes necessitate a corre-

sponding increase of the surface area of the insoluble anodes, unless a reduction of the polarization effect of the electrolyte is caused by raising the operating temperatures or by suitable stirring of the electrolyte, increasing the anode efficiency accordingly. The voltage must not exceed a certain maximum and the pH values must not fluctuate too strongly toward either side. It should be made a rule, in any case, that in order to avoid the disadvantages of iron anodes (such as the contamination of the electrolyte with iron) the percentage of iron anodes must be maintained at a suitable minimum, and to try to effect the reduction or elimination of polarization phenomena at the anodes by the other measures indicated.

Cyanide Content

The investigations of Graham and Read, Kern, Rowen, Pfanhauser, etc., have thrown much light on this problem. It has been determined, for instance, that if the cyanide content is increased up to about 75 per cent of the copper content of the electrolytes, substantial improvements are also ensured. The various methods of reducing the polarization of the copper anodes in cyanide electrolytes can thus be summarized as follows:—

1. Increase of anode area.
2. Suspension of iron anodes along with copper anodes.
3. Maintenance of voltages below a certain maximum.
4. Prevention of excessive fluctuation of the suitable pH values.
5. Increase of cyanide content.
6. Raising of the operating temperatures.

The cyanide content of the electrolytes should not amount to more than 75 per cent of the copper content in order to avoid excessive reduction of the cathodic current efficiency, while the operating temperatures of the electrolyte must not be permitted to rise above a certain critical temperature (about 30° C) since higher temperatures increase the tendency of the cyanide towards decomposition. If further improvements beyond those attainable with a maximum temperature of 30° C cannot be realized with the above expedients within the limits indicated, suitable stirring of the electrolyte, especially around the anodes, usually yields satisfactory results. The pH values should not fluctuate beyond their optimum range of 11-12.5.

Polarization of copper anodes in acid sulphate electrolytes takes place only in connection with comparatively high current densities. This tendency can be diminished or eliminated by the following expedients:—

1. Stirring of the electrolytes.
2. Increase of operating temperatures within the optimum range for the operating conditions in question.
3. Strict adherence to the approved degrees of concentration and acidity of the electrolytes.
4. Maintenance of the lowest degree of current density possible under the general operating conditions involved.

The physical condition of the anodes also exerts a considerable influence on polarization. Rolled anodes exhibit a higher static potential than cast anodes. Addition of glue to the electrolytes does not diminish anodic polarization, as is often supposed, but actually tends to favour it. The same applies to the addition of sulphite residues.

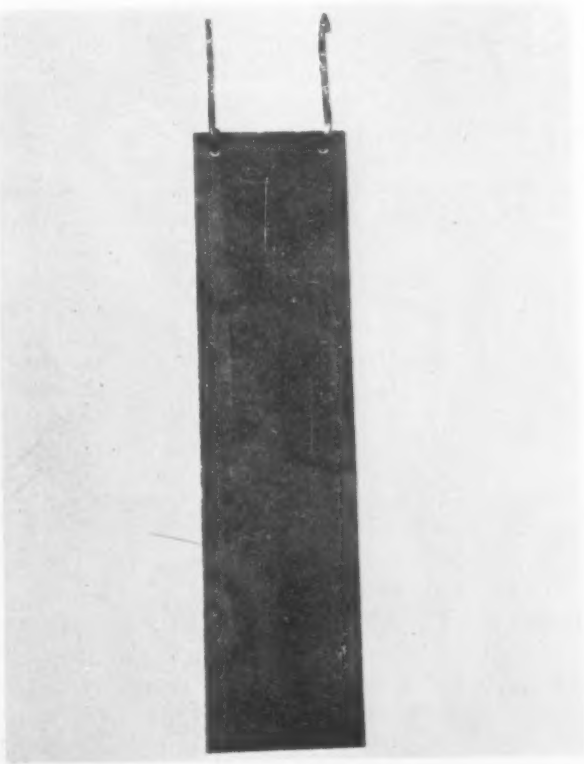
Cathodic Polarization

Attention should be called to the fact, however, that the electrolytic process cannot be based exclusively on the consideration of anodic polarization, but that cathodic polarization as well as a number of other factors—not always in conjunction with anodic polarization—must be considered at the same time. For instance, while some of the expedients already mentioned, such as stirring of the electrolyte, increase of operating temperatures, addition of glue, etc., act on anodic and cathodic polarization alike, other factors, such as the presence of sulphite residues favour anodic polarization but reduce cathodic polarization considerably.

Practical experience has indicated beyond doubt that in contrast to frequent opinions the percentage of free acid in sulphate electrolytes does not appreciably influence anodic or cathodic polarization. Impure anode copper exhibits increased tendency towards polarization but this point is of small practical importance if electrolytic copper is used exclusively, unless it has been contaminated with cuprous oxide and/or phosphorus during melting or with rolled-in oxides and scale by faulty intermediate annealings and pickling treatments. The normal impurities present in standard electrolytic copper are so insignificant that they have no influence whatever on anodic polarization or on any other of the technical properties in question.

Insoluble Anodes

It has already been mentioned in connection with



(Courtesy Hanson-Van Winkle-Munning Co.)

Fig. 6. Electrolytic plate-type copper anode.

anodic polarization in cyanide electrolytes that the use of certain small percentages of iron anodes in addition to copper anodes diminishes the tendency of the latter to polarize. This action is due not only to a corresponding reduction of the anodic current density in proportion to the cathodic current density, but to a direct influence on the copper anodes. The same applies to most insoluble anodes in all types of electrolytes, although opinions concerning these points still vary considerably. A typical instance of these controversies is the diversity of opinions concerning the action of iron anodes. In contrast to the opinions held in this respect by the author and numerous authorities in the U.S.A., England and the Continent, there are other experts who are strictly against the use of iron anodes in addition to copper anodes, preferring either to use a correspondingly larger number of copper anodes or to work with iron anodes exclusively—keeping up the required metal concentration of the electrolyte with the addition of copper salts. In the latter case it becomes necessary, of course, to analyse and correct the bath every few days.

Similar conditions prevail in connection with the use of insoluble hardlead anodes in acid sulphate electrolytes, although it appears that the majority of authoritative opinion is now in favour of the simultaneous operation of these anodes with copper anodes. Where the percentage of insoluble anodes in these electrolytes is sufficiently large to cause a gradual diminution of the copper content, and a corresponding increase of the acid concentration, in order to avoid too pronounced a dilution of the electrolyte and too strong a diminution of the pH value, the electrolytes must be freshened up and, at the same time, deacidified to normal proportions by regular additions of suitable amounts of copper carbonate.

The same applies to the use of iron anodes in cyanide electrolytes if these are used exclusively. The amount of copper deposited on the cathode per ampere/hour being known, it is easy to calculate the quantities of copper salts to be added at regular intervals in order to replenish the copper content of the electrolytes and to bind the cyanide liberated. 18.33 oz./gall. copper cyanide and 7.2 oz./gall. cuprous oxide must be added for every 100 ampere-hours, the cuprous oxide additions binding the cyanide liberated during electrolysis. It is important, however, not to add the copper salts directly to the electrolytes but to dissolve them in a few gallons of electrolyte solution and to add the latter to the electrolyte proper. It is obvious that if the replenishment of the cyanide baths is regulated by calculation, the ammeter must be observed regularly in order to ensure a perfect basis for calculation.

BRASS ANODES

Brass anodes are used in the form of cast anodes, rolled anodes and brass sheets. A large majority of these anodes are composed of the conventional standard brass alloy 70/30 but may exhibit practically any copper-zinc ratio from pure copper to the 60/40 alloys, the most common anode alloys being the 80/20 and 70/30 mixtures. It has been, and still is, a custom of older plating plants to adapt their anode compositions exactly to those of the brass platings desired, but it will be shown that this practice does not take into consideration the results of modern investigations and conceptions.

Zinc Contents

The 70/30 alloy corresponds to the usual composition of brass platings and, accordingly, of brass electrolytes, but much better results are obtained if the zinc content of the brass anodes is reduced by 10 or 15 per cent, the missing percentage of zinc being added to the electrolytes in form of zinc cyanide, potassium-zinc cyanide or some other suitable zinc salt. It should also be considered in connection with the choice of metal ratios that the appearance of brass platings varies considerably from that of the cast alloys themselves, the colour of the plating usually being much paler than that of the cast alloys. It is true that the appearance of the brass plating can be considerably influenced by intelligent variations of several electrolytic characteristics, chiefly the zinc and cyanide contents of the electrolyte or the pH-values (which comes to the same final results), but this practice is faulty in every respect since it introduces new dangerous factors contrary to the chief principle of all technical operations: to reach the desired results without complicating matters more than necessary. Reduction of the zinc content of the anode alloys and addition of corresponding amounts of zinc salts to the electrolyte therefore is the most practical way of getting results.

Indeed, it has been found by many experts that under certain operating conditions straight copper anodes offer considerable technical advantages over brass anodes of any composition whatever. Chief advantages of this type are claimed to be the following: (1) Certain difficulties connected with the copper and zinc supply to the electrolyte are thereby avoided. (2) The zinc content of the brass electrolytes is more easily controlled and regulated. (3) The use of copper anodes renders the addition of a number of special substances such as sodium bisulphite, caustic soda, ammonia, Rochelle salt, etc., unnecessary, avoiding the secondary disadvantages introduced by these special constituents.

80/20 Alloy

However, in spite of the advantages claimed for pure copper anodes on one hand and for the 70/30 brass anodes on the other it appears to be the general practice in most countries to use 80/20-brass anodes.

Brass anodes must always be composed of purest metals, preferably of electrolytic copper and zinc. Addition of brass scrap or of intermediate products made from brass scrap (even if fire-refined) should not be tolerated. Even small percentages of impurities such as tin, iron and lead will cause serious difficulties leading to faulty products and troublesome interruptions of the process. Iron and lead tend to render the anodes passive, while all three of the impurities named induce excessive formation of surface accretions on the anodes, rendering them practically insoluble. Slight accretions of this type are formed even on purest brass anodes in spite of faultless electrolytes and perfect

current conditions. They are practically harmless. If, however, they exceed a certain maximum thickness in spite of pure anodes and faultless current conditions, the electrolyte contains insufficient quantities of potassium cyanide or conducting salts—or, in some cases, an excess of carbonates (if the electrolyte is too concentrated). It is often possible to dissolve these accretions merely by interrupting the electric current, after adding some cyanide. If the accretions are not dissolved in this manner it is necessary to remove them with a long-handled brush without lifting the anodes from the electrolyte or interrupting the current, stirring some potassium cyanide into the solution at the same time. This addition of potassium cyanide must not be too large, however; it should suffice only to reproduce the original water-clear or yellowish coloration of the solution and gradually to dissolve the slimes brushed off the anodes.

If after this treatment excessive slime formation continues, and if the cyanide and carbonate contents of the electrolytes are regulated it is necessary either to select still purer anodes or, where purest alloys are already used, to reduce their zinc content, making up the lack of zinc by adding a correspondingly larger amount of zinc salt to the electrolyte.

Fault Determination

It is not always necessary to carry out complicated tests in order to discover the real reason for difficulties of the type mentioned since practically every fault leaves some outside indication discernible to the expert. For instance, insufficient cyanide content is indicated by pale brass platings (these may also be due to pH-values above 10.3) and by white and/or red stains on the plating. Excessive carbonate content, besides causing the accretions already mentioned, may also induce the formation of blisters on brass platings, especially on iron or steel bases. This latter fault may also be due to passive base metal, oxides in the pores of the base metal and to hydrogen content in the cathodic surface, which, however, does not cause excessive slime formation at the same time.

Brass plating processes, like most other plating processes, are influenced to a high degree by the physical state of the anodes. While in copper electrolytes rolled anodes are generally conceded to yield best results under all normal operating conditions, cast anodes seem to be generally preferred for brass plating work. Contrary opinions are chiefly due to the fact that the finishing treatment of the anode castings is not in accordance with the following procedure:—

1. Scrubbing with coarse sand and water.
2. Pickling in dilute nitric acid.
3. Thorough rinsing with water.
4. Pickling in dilute sulphuric acid.
5. Dipping in concentrated nitric acid, or
6. Sand blasting.

The final treatment in concentrated nitric acid is necessary to remove the casting skin of the anodes which is practically insoluble in dilute nitric and sulphuric acid solutions. Blasting with coarse, sharp-edged sand or steel shot is simpler and more economical than the acid treatment and gives practically equal results.

Rolled brass anodes do not offer any advantages over cast anodes. They yield practically equal results if the finishing annealing and pickling treatments are carried out to specifications. The only disadvantage of practical importance is, that on account of their dense structure and smooth surface, rolled brass anodes do not dissolve as readily as cast anodes, requiring more frequent or larger additions of metal salts to the electrolyte.

Careful annealing of rolled brass anodes is absolutely necessary to ensure uniform solution and to increase the rate of corrosion of the anodic surface. Annealing temperatures: 480-510° C. Annealing periods: 3 to 5 hours. Pickling is carried out with dilute nitric acid.

Sheet brass anodes may also be employed for this purpose if correctly annealed and pickled, although the results are less satisfactory than those obtained with rolled and, particularly, cast brass anodes.

Rolled and sheet brass anodes can be employed only if their surfaces are entirely free from rolled-in oxides and scale. Rolling and pickling must therefore be carried out with particular attention to this fault.

FABRICATING STAINLESS STEEL

(*Concluded from page 67*)

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Laboratory Tests and Equipment

CONCLUSION

By J. B. Mohler and H. J. Sedusky, *Research Chemists*

Editors' Note: Part I of this article appeared in the January issue, and covered Gravity, Conductivity, Throwing Power, and Current Density tests of plating baths. This article discusses various tests for evaluating the deposited metal.

Adhesion

A GOOD electrodeposit must adhere properly to the basis metal. This is an easy thing to say but it is not easy to test. If a little time is taken to study the comments on research Project No. 3 of the American Electroplaters' Society it becomes readily apparent that there are many difficulties encountered in measuring adhesion.[7]

If there is very little tendency for a deposit to adhere to the basis metal then adhesion might be readily tested. If adhesion is poor, the deposit will usually separate from the basis metal by bending, twisting, burnishing or scratching the piece. However, if the deposit is thin such tests may not be successful. A deposit of 1 mil thickness is usually easier to test than a deposit of 0.1 mil in thickness. Very thin deposits tend to follow the deforming that is done to the basis metal. These thin deposits do not have enough total strength to follow the action of a mechanical force that will tend to loosen them. A thicker deposit may be readily separated from the underlying metal. For example, take 1 mil of silver over steel. If the silver is deposited directly on steel it will not bond. In order to obtain bond, cleaning, pickling and striking is necessary. A one mil deposit of silver directly over steel may be readily stripped from the steel. The deposit may be scored with a knife to loosen it, then stripped cleanly from the plate by hand. Burnishing of such a prepared specimen will readily show lack of adhesion. In fact the application of almost any type of mechanical force will result in evidence of bad bond. The total strength of the silver aids in the test as compared to a thin deposit.

If the deposit is a high tensile strength metal, then thin deposits are more readily tested. A thinner layer of nickel may be stripped from steel if the bond is bad than in the case of silver. A few tenths of a mil of non-adherent nickel will readily respond to a burnishing test. But if a metal is strong and thick it may be so strong that it will not respond to a force even though it does not adhere to the basis metal. Ten mils of nickel may not respond to a burnishing test even though it can be readily stripped by hand.

It is now apparent than an adhesion test may depend on the strength and the thickness of the plated metal.

There is no satisfactory universal test for adhesion. A special test must be developed for each application. The best one can do is to look up the experience of previous workers and find an example as close as possible to that of the required application.[8] The test may be performed by bending, twisting, burnishing, pounding, scratching, chiseling or heating. The test may be done by hand, it may be done with tools, or it may be done with the aid of a fixture.

The best we can do at the present time is to indicate the types of tests that may be tried.

Bending: A plated sheet may be bent to a 90 degree angle, then bent through 180 degrees to a 90 degree angle in the opposite direction. Examination in the bend may show failure. If the piece does not fail it may be bent back and forth until the basis metal fails. The deposit may then be examined in the area of the failure. If the deposit shows a tendency to pull away in this area, a knife blade may be inserted between the plate and the basis metal to test for degree of adhesion. A simple bend over a definite radius may be sufficient in the case of brittle materials. If the piece is scored at a right angle to the direction of the bending force and prior to bending, it may peel in the area of the bend. This is particularly true of brittle materials. Figure 11 illustrates the bend test for a brittle material.

Twisting: A twisting test may be performed with two pairs of pliers. This type of test is more severe than a simple bend and may show failure at the point where the twisting action is most severe. See Fig. 12.

Burnishing: If a smooth blunt tool is rubbed back and forth over a deposit, blisters may develop. Tests of this nature may be used where the piece is massive and cannot be bent or twisted. See Fig. 13.

Pounding: A deposit may be pounded with a hammer. If a more reproducible test is required a load may be dropped from a definite height. The clapper of an electric bell may be used for a number of

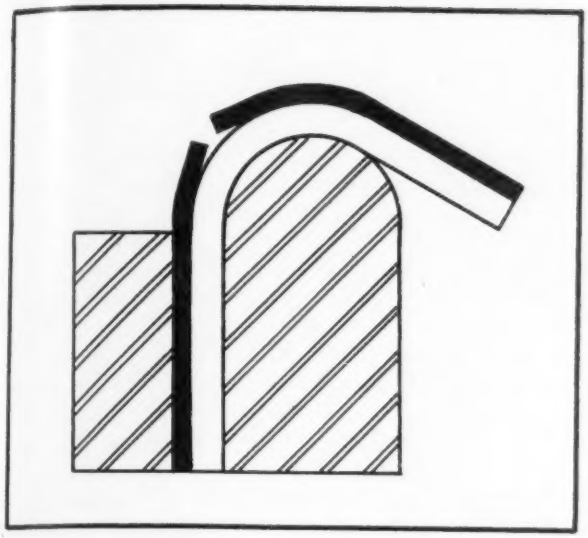


Figure 11. A bending test.

small rapid blows. A shot blasting or sand blasting machine may also be used. The success of the test depends, as in all adhesion tests, on:

1. The characteristics and thickness of the basis metal.
2. The characteristics and thickness of the plated metal.
3. The presence of brittle layers at the bond line.
4. The degree of adhesion.

Heating: Heating of a deposit may produce blisters. The blisters are usually an indication of "spotty" bond, or the presence of cracks or holes in the basis metal. If there is no bond, the test may show nothing since the whole plated layer may expand freely.

Rapid heating or rapid cooling of a hot piece may show cracking. Heating in air will often result in blistering at a lower temperature than heating in oil.

Black Light: In this test the piece is heated in oil and allowed to cool with the oil on it. The surface oil is removed and the piece is heated again to drive small amounts of absorbed oil out of pores and cracks. These areas may be detected by examination under ultra-violet light, under which conditions these areas will fluoresce.

This modification of a heating test is only applicable where bond is bad and where the bad area extends to the surface. The bad area may be exposed by mechanically removing part of the deposit before testing.

Scratching: A series of scratches may be made in a surface as a test of adherence. If the scratches cross one another, failure may take place in this area.

Many platers know that poor adherence may often be detected by scratching and scraping a deposit with a knife blade.

Chiseling: If a deposit is sufficiently thick a chisel may be used as a testing tool. The test is quite severe and gives a rough indication of degree of adhesion.

Quantitative Tests: Perfect adhesion consists of a chemical bond between the deposit and the basis metal. The plate is then bonded to the basis metal by atomic forces and the bond strength is likely to be greater than the tensile strength of the weaker of the two metals concerned. In order to evaluate any of the qualitative tests already mentioned it is desirable to have specimens that are bonded and specimens that are not bonded.

The only sure way to know what procedure to use to obtain bond is to determine the bond strength. This must be done by a quantitative test that measures the bond strength in pounds per square inch. By means of such a measurement a practice may be established that will insure bond. The practice may then be used as a basis to study qualitative tests. The quantitative test cannot be used for production pieces because it requires a special specimen and can only be used for thick deposits (15 to 100 mils).

The Ollard test is recommended for the quantitative study of bond. Figure 14 shows a setup of one modification of the Ollard test.

A specimen is prepared and machined as shown. The bond area is ring shaped. The specimen is placed in a holder and a force is applied by the use of a rod in a tensile testing machine, until the point of failure is reached. From the area ruptured and the load applied, the bond strength is calculated in pounds per square inch.

Hardness

At times it is necessary to measure the hardness of a deposit. Such measurements may be made to meet a specification or they may be made to determine the hardness obtained by a specific plating practice.

If a thick deposit is prepared and a hardness machine is available the measurement is simple and reproducible. Thick specimens are not always easy to prepare and often they have to be ground smooth previous to testing. If such grinding is done it must be done carefully with a wet wheel to prevent hardening of the specimen by the grinding operation. In addition to hardening by this operation, the piece will harden during the test so that the hardness induced by cold working during the test must be reproducible. This is accomplished by having the specimen sufficiently thick. The specimen ought to be about ten times as thick as the depth of penetration during the test.

Figure 15 shows a diagrammatic cross section of

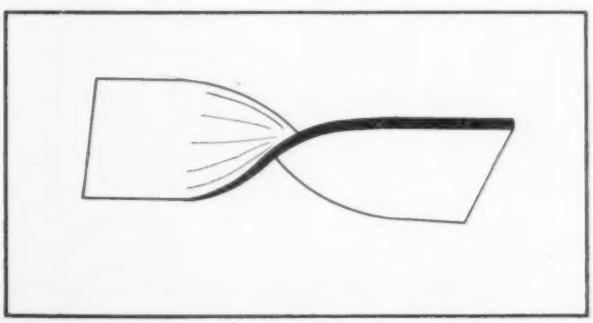


Figure 12. A twisting test.

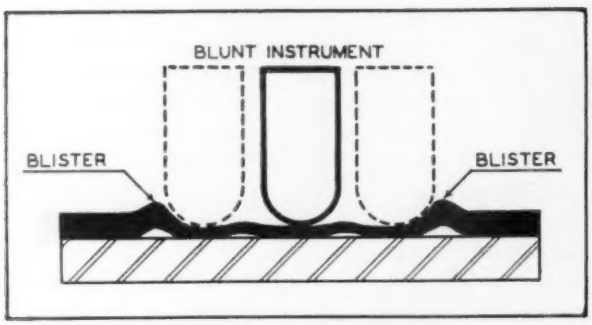


Figure 13. A burnishing test.

the stresses induced around an indent made by a hardness machine.

If these stresses extend to the base metal then the base metal will have some influence on the test.

Two of the hardness tests available for testing thin deposits are, namely, the micro-character and the Knoop test. In both of these tests a microscope is required to measure the width of the mark made.

The following methods are available to measure or estimate hardness.[9, 10, 11]

A. *File Test:* A metal not scratched by a standard file is designated "file hard". The surface to be tested is rubbed slowly but firmly with a sharp file until it is apparent whether the file will or will not bite.

B. *Micro-Character:* The width of minute scratches made by a pyramidal shaped diamond drawn across the surface under a load of three grams is measured with the aid of a microscope and taken as an indication of the hardness of the metal. Fig. 16 shows the type of equipment used for this type of test.

C. *Brinell Test:* The area in square millimeters of indented surface on a smooth metal specimen, caused by a small hardened steel ball under definite loading, is divided by the load in kilograms to give a Brinell hardness number.

D. *Rockwell Test:* The depth of indentation either by a diamond brale or by a hardened steel ball is used as a measure of hardness.

E. *Vickers Hardness Test:* This is similar to the Brinell test except that the length of the diagonal across the square base of a pyramidal indentation made by a diamond under suitable loading, is measured microscopically and used as a hardness factor.

F. *Knoop Hardness Test:* This is similar to the Vickers test except that the indentations are very small and the diamond has a length of about seven times its width and 30 times its depth. See Fig. 17 for illustration of this tester.

G. *Monotron Hardness Test:* The load is measured that is required to force a hemispherical indentor a fixed distance into the specimen.

H. *Shore Scleroscope Test:* The height of rebound of a diamond-faced hammer dropped through a fixed distance onto the specimen is proportional to its hardness.

I. *Cloudburst Test:* Hardened steel balls are dropped from a height of about four meters onto the specimen, and the diameter of the impressions made are measured microscopically and converted to the Brinell scale.

Thickness

The life of an electrodeposit is primarily dependent on its thickness. It is therefore important that sufficient thickness be deposited to satisfy service conditions.

The average thickness may be calculated from the total weight of the deposit. This weight may be determined for a specific plating procedure by running a pilot piece and weighing before and after plating. If such a procedure is used the piece should not be etched or pickled previous to plating unless a heavy deposit is required. If metal is removed previous to plating it will obviously cause an error in this method. If it is necessary to pickle the part, it should be pickled, dried and weighed. It should then be degreased and cleaned by such a procedure that it will not lose appreciable weight before plating, and that a smooth non-blistered plate will be obtained. If the weight of deposit on a specific piece is desired, then the deposit must be stripped. If the deposit can be stripped without removal of the basis metal then the weight can be determined by weighing the test piece before and after stripping. Silver can be stripped from steel by anodic treatment with cyanide solution and chromium can be stripped from steel by anodic treatment with caustic solution without attack of the steel. If the basis metal is attacked then the total metal in the solution obtained can be determined by chemical analysis and the weight of deposit can be calculated.

Under carefully controlled conditions the deposit can be stripped chemically and the time required for the stripping operation is a measure of the local thickness. This can be carried out in a number of ways:

1. The part may be immersed in the chemical solution.
2. A drop of the stripping solution may be placed on the part and the time noted for complete local removal of the deposit.
3. The solution may be allowed to fall dropwise on the part until the deposit is removed.
4. The solution may be impinged on the part in a steady stream until the deposit is removed.

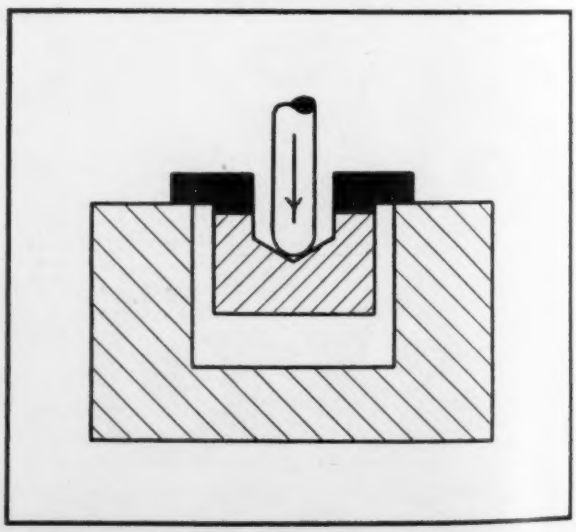


Figure 14. The Ollard Test for adhesion of heavy deposits.

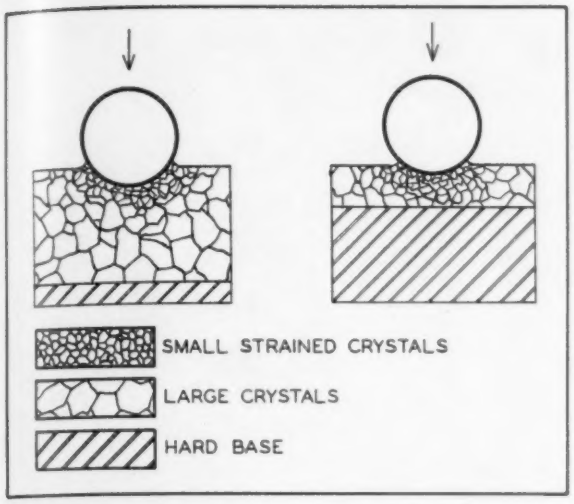


Figure 15. Stresses induced during a hardness measurement.

Chemical reactions change in rate due to change in concentration during attack, changes in temperature and changes in solution flow conditions. These variables, plus the effect of the surface condition at the start of the chemical attack and the difficulty in deciding when the basis metal is exposed, limit the applicability of the stripping test methods. In general these methods find their greatest use in testing thin deposits.

The thickness of thin chromium coatings may be measured by applying one drop of concentrated hydrochloric acid to the surface.[12]

A solution containing 200 grams per liter of CrO_3 and 50 grams per liter of H_2SO_4 may be used to test the thickness of zinc and cadmium[13] by the dropping test. The dropping rate must be controlled and this may be done with ordinary laboratory equipment or with special commercial equipment that is available.

A solution containing 300 grams per liter of ferric chloride and 100 grams per liter of copper sulfate may be used in a jet test to determine the thickness of nickel coatings.[14]

The rate of attack of a surface may be controlled by electrochemical means. If the test piece is made anodic and the ampere minutes recorded for the time required to just remove the deposit at 100 per cent anode efficiency then the thickness may be calculated. Such a method was used for determining the thickness of chromium, using a solution containing trisodium phosphate and sodium sulfate. This method would be general for any case where a solution could be used that would dissolve the plate with 100 per cent anode efficiency and where the endpoint could be recognized either by a change in the ammeter or voltmeter reading or by gassing of the base metal.

Thickness may be measured by the microscopic method, which consists of examining a carefully polished section under the microscope. The method destroys the piece and requires special equipment and considerable practice. It is sometimes used to determine variation in thickness over a complicated shape. If the deposit is soft, it is often necessary to deposit in order to obtain a harder metal over the metal to be examined in order to obtain a specimen that does not have the edge rounded or flowed during the polishing operation.

Figure 18 shows a cross section of silver plate over steel to show the thickness obtained in a corner section. Copper was deposited over the silver in order to increase the accuracy of the method by the added contrast of the two metals.

Thickness may be measured by magnetic methods if the deposit or the basis metal possess magnetic properties. Several instruments of this type are available.[15] See Fig. 19. If this instrument is used, standards should be available for frequent checks and care should be taken that the test piece does not become magnetized during manufacturing operations. Thin specimens of a few tenths of a mil or less are generally more difficult to measure by this method than thick specimens.

Porosity

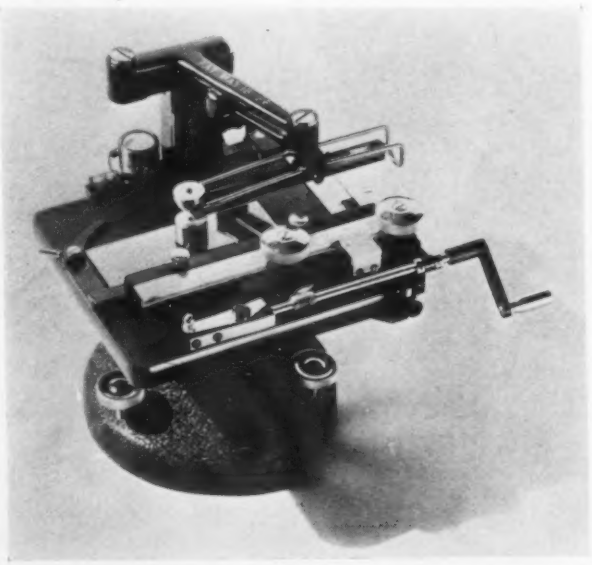
It is desirable to measure porosity when the basis metal has a greater tendency to corrode than the deposit.

The number of pores per unit area may be regarded as an indication of the corrosion rseistance of the part. The results from porosity tests may also be used as a control tool.

Thickness alone does not guarantee a minimum porosity. It is known that porosity may be due to poor plating, poor preparation of the piece to be plated, or inferior stock on which to plate.

Porosity tests are not definite, like specific gravity. First, they are difficult to reproduce; and second, they are difficult to interpret. Nevertheless, they are easy to carry out, they are useful, and the porosity may vary so widely that reproducibility and interpretation are not of too much importance.

As an example: it was desired to determine the minimum thickness of nickel plate over steel for a definite plating procedure and for a machined steel surface. The following results were obtained by the hot water test:



(*Courtesy American Optical Co.*)

Figure 16. Bierbaum Microcharacter for accurately producing scratches in metal surfaces.

TABLE No. 6

Thickness of Nickel—Mils	Pores per Square Decimeter		
	Machined Surface	Rolled Surface	Ground Surface
.05	25,000	350	70
.1	8,000	95	5
.2	1,700	20	0
.4	400	3	0
.8	0	3	0

From a test of this type all the specimens may be tested at the same time. Then it is likely that the same relative results will be obtained on running a second test series.

The salt spray test is a porosity test, but it is not a rapid test. If a definite test is not specified then one of the common tests may be used.

Hot Water Test: Immerse the specimen in distilled water for six hours at 90 to 95° C.

Ferroxyl Test: Pour a warm solution of prepared reagent over the surface of the specimen.

The gel will set and a black color will develop at each pore.

Ferroxyl Reagent:[16]

	Grams per Liter
Sodium Chloride	60
Agar-Agar	10
Potassium Ferricyanide	0.5

Ferroxyl Paper: Soak a 50 per cent white rag bond paper in the warm reagent. Allow to drain and dry.

Wet the paper and press it onto the surface of the specimen. Keep moist and allow it to remain for ten minutes to develop the blue spots.

Ferroxyl Print:[17] Coat one side of a 25 per cent rag bond paper with the following warm solution (35° C):

	Grams per Liter
Sodium Chloride	50
White Gelatin	50

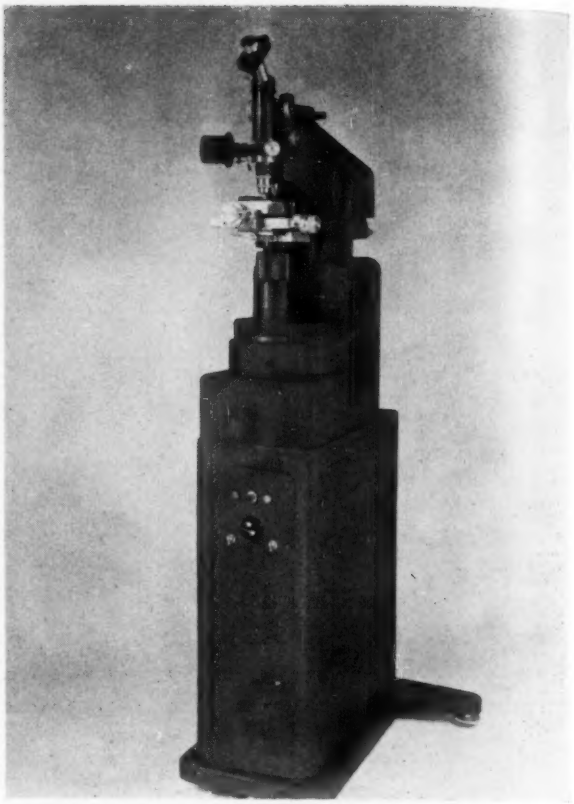
Allow the paper to dry. Soak the paper in a solution containing 50 grams per liter of sodium chloride and press it onto the specimen with the gelatin side down. After ten minutes remove the paper and place it in a solution containing ten grams per liter of potassium ferricyanide to develop the blue spots.

Electrographic Test:[18] Moisten a sheet of filter paper with a 5 per cent solution of sodium nitrate and place it on the specimen. Place a sheet of metal over the paper (platinum, lead or nickel). Make the specimen the anode and the sheet of metal the cathode. Pass a current of 30 milliamperes per square decimeter for three minutes. Develop the paper for one minute in a solution containing:

Potassium Ferrocyanide	50 g./l.
Glacial Acetic Acid	30 ml./l.

Copper Immersion Plate: Immerse the specimen for one-half minute in a solution containing:

	Grams per Liter
$CuSO_4.5H_2O$	10
H_2SO_4	50



(*Courtesy Wilson Mechanical Instrument Co.*)

Figure 17. Knoop hardness tester.

Copper will immersion plate at each pore.

Copper Electrolytic Plate: Make the specimen cathodic in an acid copper plating bath at 0.2 volts for two minutes.

TABLE No. 7

Plate	Basis Metal	Method
Nickel Tin Chromium Silver Copper	Steel " " "	Ferroxyl Test or Hot Water Test
Nickel Nickel	Copper or Copper Base	Electrographic Test
Nickel Chromium	Zinc Base " "	Copper-Immersion Plate or Salt Spray
Chromium	Nickel Brass Copper	Copper Electrolytic Plate

If porosity is measured, it is well to run several different tests. It is also advisable to run a number of specimens and, if possible, to run a standard at the same time. After some records are accumulated, one test may be selected.

Corrosion

The problem of corrosion is one that the plater faces continuously.

The plated piece must have some corrosion resist-

ance as determined by a standard salt spray test, a porosity test or a humidity test.

Corrosion testing does not end here, for coatings are occasionally called on to withstand special conditions. The least that can be done in this case is to test various electroplates exposed to these same conditions.

Corrosion is also a factor in the plating room and simple immersion tests will often make it obvious that a new material will not be satisfactory for a material of construction.

If a corrosion problem is encountered for which there is no history, no standard or no known rapid test, then a test may only be made under conditions simulating the service requirements as closely as possible. The requirements may be for a container to hold a weak organic acid or they may be for a material to be used for a plating tank. A new resistant paint may be offered to coat metal hoods used to carry off acid fumes or a material may be offered for construction of a plating rack.

If a material is offered for a plating tank or a plating rack then samples should be obtained and cut into specimens. These specimens should be immersed in every solution in which they are to be used. They may be placed in bottles in the laboratory. They may be totally immersed, or half immersed or they may be hung in production tanks. The testing time is only limited by what may happen to the specimens and the importance of the application. The specimens may fail in a few days and the test is complete. If they do not fail in several months a full scale trial may be made. If the application involves considerable expense then longer testing times are in order.

It is well to weigh the specimens at the start and at various intervals during the test. If they are metallic, the corrosion rate may be calculated from the weight loss in units such as milligrams per square decimeter per day. If the specimens are organic they will often gain in weight and excessive gain amounts to failure. Excessive gain means either warpage or that the testing solution will penetrate the organic material and attack any supporting corrodible material.

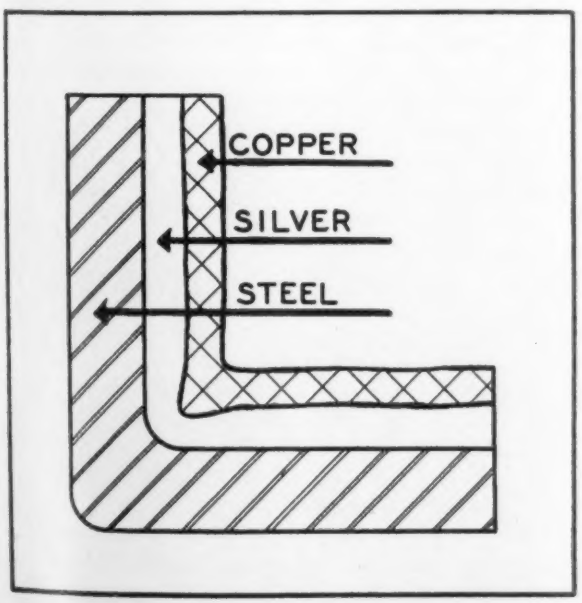


Figure 18. Corner affect on a silver deposit.

Immersion tests may not give the best answer to a corrosion problem but very often they pick out the materials that fail readily. Those materials that pass an immersion test can only be tested by service.

Extensive data on immersion tests are available in handbooks and in the manufacturer's literature.

Shelf Life

Many of the plated articles that are sold are destined to stand in storage, on a shelf or in a display case for several years before they reach the consumer.

If a large volume of material is to be plated over a period of years it is a simple matter to plate a number of specimens and place them in storage. They may be stored wrapped and unwrapped and they may be stored in dry and moist places. They may be stored indoors and outdoors.

Such a test is a long time test but it has the advantage that conditions close to actual service can be selected. Once results are obtained from such a test the chemist may go to work and see if he can develop a rapid bench test such that one day of testing will equal one year of shelf life.

Outdoor Exposure Tests

If a material is to stand outdoor conditions then that is the place to test it. Unfortunately this is not as simple as it sounds since a given year selected for testing may be abnormal in that it has an excessive amount of rainfall. Also the material will test different in Maine than in Florida and different near a city than in the country. Since these tests take time, the specimens should be carefully prepared, they should be placed in proper racks and in a proper position on the rack. Such tests are usually conducted by the U. S. Bureau of Standards or by large companies that are vitally interested in outdoor conditions.

If there is an interest in outdoor exposure tests it is well to look up available literature on the subject. However, for casual interest or for rough testing there is no reason why one should not place a number of plated pieces on his roof and go up and examine them periodically. There is always the chance that failure will be rapid and some simple change will correct it.

Humidity Cabinet

A deposit may be tested for resistance to moist air by exposing it to a high humidity. The temperature may also be increased for such a test and the combination of high humidity and elevated temperature will accelerate corrosion. Many tests are run at a relative humidity of 90 to 100 per cent and temperatures of 25 to 50° C.

Special cabinets may be purchased or constructed to control humidity; or a cabinet may be used to operate at 100 per cent humidity by passing all air

that enters the cabinet through water. Care must be taken in the operation of such a cabinet that water does not condense on the specimens.

The humidity cabinet is of value to test the corrosion resistance of stock to be plated and to test various oils and coating materials used to protect stock for the time that the stock is stored in the plating room previous to plating.

Salt Spray

The salt spray test consists of a salt fog that will cause corrosion of specimens which are exposed to it.

For rough work, a simple container and an atomizer may be set up. But it is doubtful if the salt spray should ever be used for rough work since a more simple type of corrosion test may be used.

For accurate salt spray work the greatest attention should be paid to details. The work of H. P. Troendly[19] should be studied as well as the recommendations of the American Society for Testing Materials.[20, 21]

Troendly recommends the following control for a salt spray box.

1. Air entering the box must have 84 to 90 per cent relative humidity inside the box.
2. The temperature of the box must be maintained from 92 to 97 degrees Fahrenheit.
3. Atomization should be controlled so that ½ to 3 c.c. per hour of fog is collected through 10 cm. diameter glass funnels at the specimen level.
4. The collected fog should test 18 to 22 per cent salt.
5. The pH of the salt solution should test 6.5 to 7.2.
6. The specific gravity of the salt solution should be 1.126 to 1.157 at 95 degrees Fahrenheit.
7. The box and humidifier materials should be non-corrodible in the salt solution.

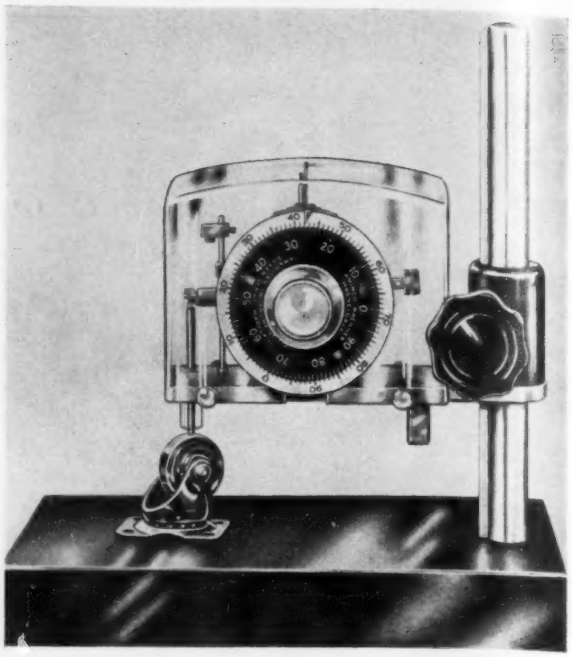
If the salt spray test is used for a specification then the cabinet should be operated under recommended conditions. See Fig. 20. Because it is widely used as a specification is no reason that it should not be used to study a specific corrosion problem.

C. F. Nixon[22] showed how the salt spray may be modified and used as a guide for a specific corrosion problem.

Nixon observed the following facts for copper, nickel and chromium deposits over zinc base die castings:

1. Plated die castings fail more readily outside than inside.
2. Failures occur more readily in the winter than in the summer.
3. Failures occur more readily in industrial atmospheres than in country atmospheres.
4. The snow in industrial atmospheres tests pH lower than 7.
5. Standard salt spray failures do not look like service failures.
6. Failures in an acidified salt spray do look like service failures.

Figure 21 is a diagrammatic sketch of the type of failure that occurs both in service and in a 20 per cent salt spray containing one per cent of glacial acetic acid.



(*Courtesy American Instrument Co.*)

Fig. 19. Plating thickness tester using the magnetic principle.

The acidified salt spray was tested and it was found that 24 hours' testing at 115 to 125° F. was equivalent to one year's exposure at Detroit or Florida. It was also found that a total thickness of .8 mil with a minimum thickness of .2 mil of copper would pass the 24 hour test.

Nixon suggests that further work be done before the acidified salt spray be accepted but the test illustrates the value of a bench test where so many hours of testing equal one year of service.

Such a test may be used to determine the thickness of deposit required as well as the effect of zinc casting practice, polishing, cleaning, and plating procedures.

Rapid Plating

There are ways in which the plating range of a bath can be extended. A simple way to do this is to increase the metal content, but depletion of metal near the cathode limits the maximum current density that can be used and still obtain a satisfactory deposit. As the metal is depleted in the cathode film, it is necessary that metal be supplied to replace it. This supply takes place by diffusion of soluble metal across the film. If the rate of supply of current is higher than the rate at which an electrochemical equivalent of metal reaches the cathode then hydrogen will deposit. In an alkaline tin bath this would merely mean a drop in cathode efficiency but in many baths it would mean inferior plating.

The most effective way of replenishing the metal near the cathode is to move the cathode or to move the solution. The plating rate then depends on the rate of movement and with high movement rates rapid plating can be obtained.

The point at which excessive polarization begins is known as the limiting current density. By means of agitation or cathode movement the limiting current density can be greatly increased.

There are a variety of ways to study the increase in limiting current density with increase in agitation. It can be done by merely moving the solution with an agitator and noticing the increase in the point at which excessive polarization takes place. The trouble with this method is that data is hard to define in terms of a standard agitator and after it is obtained it cannot be translated to accurate plating tank design. It may be used in a simple case such as determining how such agitation can be used for electrolytic polishing of silver.

In the high efficiency copper cyanide bath the cathode movement principle is used to extend the plating range.

The most important applications of rapid plating are for the plating of strip steel or wire but rapid plating has also been applied to the plating of bearings in which case the shape of the piece was adaptable both to movement of the piece and to movement of the solution.[23]

Rapid plating can be studied in an apparatus where the cathode can be moved reproducibly. The Swalheim cell[24] is useful for such a study. This cell is fundamentally a cylinder, by the rotation of which, the limiting current density for strip plating can be determined. If excessive polarization is avoided then a series of tests should reveal that the bath voltage is proportional to the cell voltage. D. A. Swalheim showed that this was true for a halogen tin solution from 200 to 1400 amperes per square foot. The data readily demonstrated why it is possible to plate at high cathode efficiencies at current densities of over 1000 amperes per square foot. It was further shown that for the sulfamate lead bath a ratio could be established between data from the Swalheim cell at various speeds and the plating range obtained on a Hull cell.

There are other types of cells that can be used for rapid plating studies. Miniature machines may be constructed to simulate strip or wire plating. A cell may be constructed where the solution is moved reproducibly past the cathode.

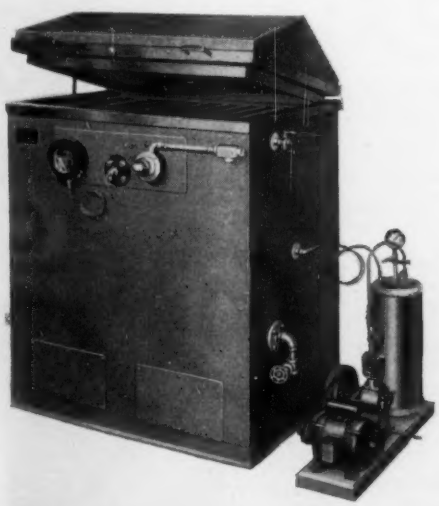


Fig. 20. Salt spray cabinet used for specification testing.

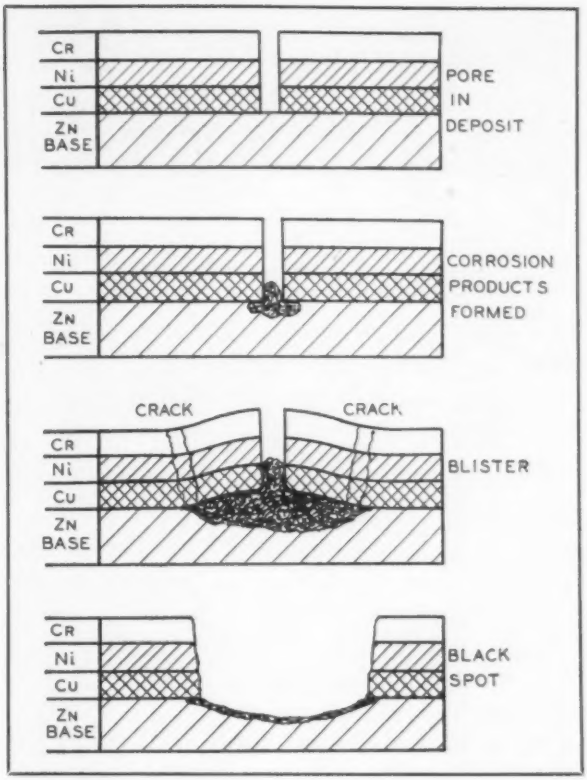


Fig. 21. Effect of porous plating in promoting early failure through blistering and cracking.

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Shop Problems

Abrasive Methods—Surface Treatments—Control
Electroplating—Cleaning—Pickling—Testing

METAL FINISHING publishes, each month, a portion of the inquiries answered as a service to subscribers. If any reader disagrees with the answers or knows of better or more information on the problem discussed, the information will be gratefully received and the sender's name will be kept confidential, if desired.

Silver Plating on Aluminum

Question: Can you tell us how to go about silver plating on aluminum on articles made from sheet materials? D. H. R.

Answer: In order to get an adherent plate on aluminum, the parts should first be given the usual zincate treatment, then copper plated, strike in silver strike solution, and final silver plate from the regular bath. Details of these various treatments are given in the *Guidebook and Directory*.

Anodes for Brass Plating

Question: I would appreciate your opinion on the best type of anodes to be used for a brass plating installation, semi-automatic, of 1400 gallons capacity. What about annealed anodes? C. E. M.

Answer: Cast Brass anodes of the composition 80% copper, 20% zinc are most generally preferred because of their easy solubility under most conditions. The anodes should be made only from the purest raw materials, and the surfaces must be thoroughly cleaned of oxides or scale before being put to use. For most applications the anodes are ellipticle in shape and straight, but in many barrel tanks and very wide still tanks they may be curved at the bottom to extend out into the solution. Cast anodes are usually not annealed, but this treatment might be beneficial in promoting uniformity of the grain structure and hence more even solubility.

Die Marks in Formed Objects

Question: We have difficulty in finishing some small parts due to the scratches left on them from the dies used in forming them to shape. Can you give us a method for polishing these economically? V. P.

Answer: You can best overcome this problem by imparting a smoother finish to your forming die, then chrome plating it to retain this smooth surface in use. These parts are too small to polish rapidly, except possibly by barrel methods, but I believe you might get some distortion of these delicate parts this way.

Another suggestion would be to have the sheet material coated with one of the protective plastic films which are available. These films offer good protection during blanking and forming operations, and can easily be removed with solvents prior to plating.

Metallizing Baby Shoes

Question What cement do you recommend for tacking down the laces of baby shoes? The lacquer subsequently used for sealing the leather seems to dissolve all the cements we tried, as well as the tips of the laces. H. L.

Answer: The solvents of most lacquers will also dissolve most cements, as well as any tips made of plastics. You can staple or pin the laces in place. The plastic tips can be removed and the ends of the laces wrapped with fine thread.

Stainless Steel Tank Linings

Question: How can I line a steel tank with stainless steel? C. R. H.

Answer: One of the ways that can be used quite successfully would be to have stainless steel sprayed inside the tank. In this way any desired thickness can be built up. There are several companies that can either do this for you or supply the necessary equipment. A list of these companies is being sent to you.

Black Anodes in Silver Plating

Question: I believe that the reason I have black anodes in my silver solution is because there is a lot of Iron in the bath. How can I remove this Iron? E. T. M.

Answer: Removing the Iron from the solution would be a complicated job. I suggest that you first increase the number of anodes that you keep in the tank to reduce the anode current density, then make sure that you have at least 4 oz/gal of "free cyanide" present at all times. Only the highest purity silver anodes should be used.

Bright Dips for Cadmium Plate

Question: Can you give me the formula for a bright dip solution for cadmium plated parts? A. M.

Answer: The following solutions may be used for dipping cadmium bright:

1)	Chromic Acid	13.5 oz/gal.
	Sulfuric Acid	.125 oz/gal.
2)	Hydrogen Peroxide	7% by volume
	Sulfuric Acid	.3% by volume

The acid concentration in both these solutions must not be allowed to get too high.

Black Finish for Stainless Steel

Question: Can you furnish us with the formula for a solution for producing a black finish on stainless steel grids used in developing tanks? J. F. M.

Answer: Stainless steel can be blackened with an adherent and corrosion-resistant film in molten baths of Sodium Dichromate. The method has been patented by the Rustless Iron and Steel Division of American Rolling Mills Co. Briefly the process involves immersion of the parts in the molten Dichromate bath at approx. 750°F. The parts are then cooled in air and rinsed to remove the excess chemicals. The time required for blackening is about 25 minutes.

Refinishing Stainless Steel Sheets

Question: Stainless steel sheets having a #4 mill finish occasionally become scratched during our fabricating operations. We are anxious to find a way to restore this #4 finish by removing the scratches on the finished cabinet.

H. L. W.

Answer: Assuming that the parts are too cumbersone to polish by the usual wheel methods, I suggest that you try using a portable hand polishing machine with a buffing wheel attached. The buff may be coated with any one of several abrasive materials that can be conveniently applied to the wheel, as they contain their own binder. The abrasive should be ♯150-180 grit. The scratches may also be removed by hand, using a wood block covered with ♯150 or ♯180 abrasive cloth soaked in oil.

Maintaining Copper in Silver Strike

Question: How can I maintain the Copper Cyanide content recommended in the first strike solution for silver plating steel? G. A. C.

Answer: The copper content of approximately 1½ oz/gal can be maintained in this first strike solution by hanging a copper anode in the tank along with the silver anodes. The correct number of copper anodes required will have to be worked out by trial and error methods, having the bath analyzed at frequent intervals to chcek the copper concentration.

High Speed Polishing Lathes

Question: Can you advise us of a source for polishing lathes having spindle speeds of 10,000 rpm or better?

J. T. H.

Answer: We have checked this matter with several authorities in the field and cannot find anyone who manufactures such high-speed machines in the regular type of polishing lathes. There are some very small hand tools on the market that have speeds in this range. The maximum surface speeds of most polishing lathes is about 10,000 feet per minute, but the spindle speeds are about 3500-3800 rpm.

Chrome Plating Cast Iron

Question: We have experienced considerable difficulty with our chrome plating peeling from the cast iron parts. The parts are first copper and nickel plated. We have repeatedly checked our cleaning procedure, and have just about decided that the hardness of the nickel deposit is to blame. Rockwell readings of C-17 were found on the defective parts. What hardness do you recommend for the nickel?

C. W. S.

Answer: Rockwell hardness readings are useless for checking the hardness of plated coatings unless they are several thousandths of an inch thick. You did not make it quite clear whether the chrome was peeling from the nickel or the cast iron base metal was being exposed by the peeling. The latter condition is definitely tied in with your cleaning and dipping procedure prior to plating. Peeling of the chrome from the nickel could be caused by a "passive" condition of the nickel plating, and can be removed by a dip in 10% Muriatic Acid or a reverse etch in dilute Sulfuric Acid just before chrome plating.

Blue Finish for Steel

Question: We want to produce a blue finish on steel by immersion methods only. Can you give us the formula for a suitable solution for doing this? W. E. B.

Answer: The following solutions can be used for this purpose:

1) Sodium Hyposulfite (Hypo)	4½ oz.
Lead Acetate	1½ oz.
Water	1 qt.
Use at 180-190°F.	
Time—about 5 mins.	
2) Potassium Ferrocyanide	5 grams
Water	1 liter
Ferric Chloride	5 grams
Water	1 liter

Mix these solutions, heat to boiling, and immerse parts until the desired depth of color is obtained.

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Patents

Coated Abrasive Article and Method of Manufacturing the Same

U. S. Patent 2,431,258. *Henry P. Kirchner, assignor to The Carborundum Co.*

In a method of making an abrasive disc the steps which comprise bonding

a layer of abrasive grains to a backing comprising vulcanized fiber, forming a disc from the abrasive coated backing, drying the article to such an extent that the abrasive coated side of the article is convex and the article has a radius of curvature which is smaller than that desired in the finished article, and attaching a sheet of paper adhesively joined to a film which is substantially impervious to water vapor on the vulcanized fiber on the side of the backing which is opposite the abrasive coating by an adhesive containing water whereby the water in the said adhesive penetrates the vulcanized fiber and causes the article to assume a predetermined curvature of greater radius than that of the dried article.

Rust Inhibiting Oil Composition

U. S. Patent 2,432,901. *Sven Christian Johansson.*

A rust inhibiting oil composition comprising an oil, an alkali metal salt of a nitrophenol normally insoluble in the oil and a solvent of the group consisting of amylalcohol and amylacetate for solubilizing the alkali metal salt, the said alkali metal salt of nitrophenol being present in an amount sufficient to inhibit corrosion by the oil.

Electrodeposition of Iron-Tungsten Alloys

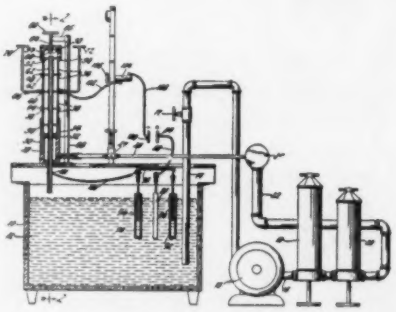
U. S. Patent 2,432,894. *Matthew Leslie Holt, and Rodney E. Black, assignors to P. R. Mallory & Co., Inc.*

The method of electrodepositing an iron-tungsten alloy which comprises passing an electric current through a bath consisting of an aqueous solution of 350 g. of ferrous ammonium sulfate, 1 g. of sodium tungstate and 3.5 N sulfuric acid in one liter of the solution, said solution having a pH of about 2.0, and the electrodeposition being performed at about 75° C.

Apparatus for Electroplating the Inside of Bearing Shells and the Like

U. S. Patent 2,431,949. *William M. Martz, assignor to General Motors Corp.*

An apparatus for electrodepositing metal on the inside of bearing shells and the like, a first tank containing a supply of electrolyte, a pressure tank, a pump for pumping electrolyte from the first tank to the pressure tank, a plurality of pipes leading from the pressure tank, a plurality of hollow supports above the first tank, each of which is adapted to support a stack of bearing shells forming a tubular cathode and each of which receives electrolyte through one of the pipes, a tubular anode of insoluble material within each of the stacks of bearing shells, spaced therefrom and extending downwardly through a hollow support,



a cap member for the upper end of each of the stacks of bearing shells and being spaced from one end of the tubular anode within the corresponding stack of bearing shells, the arrangement of each hollow anode, stack of bearing shells, and cap thus being such that electrolyte is caused to flow upwardly in the space formed by an anode and stack of bearing shells until it reaches the top of said stack and then is directed by the cap downwardly into and through the hollow anode for return to the first tank, a plurality of anodes of the metal to be electrodeposited on the bearing shells disposed in the electrolyte in the first tank, a porous cup adjacent each last mentioned anode, a cathode within each porous cup, and electrical connections from the positive side of a source of direct current to each of the last mentioned anodes, from each of the last mentioned cathodes to each of the hollow anodes, and from each of the stacks of bearing shells to the negative side of the source of direct current whereby as metal is electrodeposited onto the inside of the stacks of bearing shells a corresponding amount of metal goes into solution in the electrolyte in said first tank.

Treatment of Dross for the Recovery of Zinc

U. S. Patent 2,433,615. *George T. Mahler, assignor to The New Jersey Zinc Co.*

The method of recovering zinc from dross which comprises introducing the dross at the top of a packed column, externally heating said column to maintain (1) a melting zone near its top at a temperature sufficiently high to melt the zinc and other metals in the dross but insufficient to volatilize zinc and (2) a volatilizing zone immediately below the melting zone into which the melted dross flows by gravity from the melting zone and zinc is volatilized, and withdrawing zinc vapor from the column at a point approximate the junction of said zones.

Solution for Smoothing Zinc Surfaces

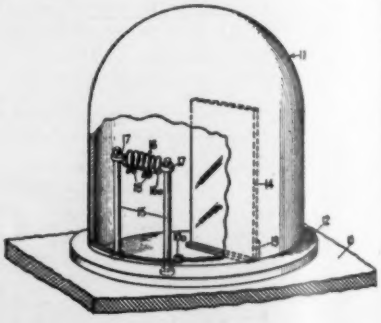
U. S. Patent 2,433,723. *Theophil J. Wieczorek.*

A composition for smoothing zinc surfaces comprising an aqueous solution of glacial acetic acid, sulfuric acid, and chromium trioxide in substantially the respective proportions 1 fluid oz., 2½ fluid oz., and 2 lbs. per gallon of water.

Process of Evaporating Metals

U. S. Patent 2,432,657. *William H. Colbert and Arthur R. Weinrich, assignors to Libbey-Owens-Ford Glass Co.*

The method of producing coatings by evaporation of a metal of the silver chemical periodic table family from a filament selected from the group consisting of tungsten, tantalum, molyb-



Cowles

KW

HIGH SPEED ALKALINE CLEANER

• Cowles KW is a fast, efficient and economical cleaner for cleaning steel, die castings, polished and unpolished brass, copper and bronze. It may be used in still tanks with or without electric current and also in all types of washing machine equipment. Cowles KW does not attack the metal.

Adaptable with Cowles KW Cleaner are Cowles emulsion type cleaners, SOAKLEEN and LIXOL. These combinations are excellent for pre-soak cleaning and ideal for preparing steel for enameling.

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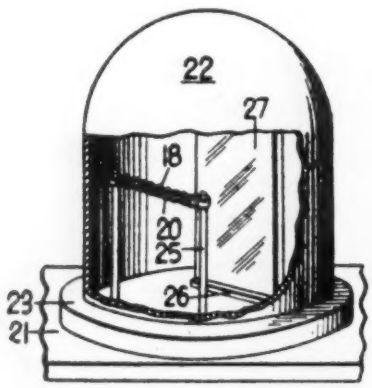
denum, and columbium, wherein the metal to be evaporated is alloyed with a metal selected from the group consisting of iron, cobalt and nickel and is heated on said filament, and wherein said selected alloying metal causes the metal desired to be evaporated to wet, to adhere to, and to spread out over the filament surfaces and by the continued application of heat, to evaporate and to deposit upon an article to be coated.

Method of Coating Surfaces with Quartz

U. S. Patent 2,432,538. *James C. Ogle and Arthur R. Weinrich, assignors to Libbey-Owens-Ford Glass Co.*

The method of coating a surface with quartz by evaporation technique within a vacuum, comprising contacting substantially the entire surface of the



quartz with beryllium, positioning the quartz and attached beryllium within an electrically heated filament in a high vacuum to heat the quartz to a high temperature and to evaporate said quartz, and depositing the quartz on a support surface, said beryllium having a melting point lower than the temperature to which the quartz is heated to effect its evaporation.

Process of Hot Coating Metal Strip

U. S. Patent 2,430,475. *William E. Marshall, assignor to The American Rolling Mill Co.*

A process of coating ferrous base metal with molten coating metal which comprises leading the metal to be coated through a bath of flux into a bath of molten supporting metal and out of said molten supporting metal through a bath of molten coating metal, the bath of molten supporting metal being divided into entrance and exit portions separated to minimize heat transfer and connected together to provide a passageway for the metal to be coated, which passageway includes a constricted throat to minimize diffusion, said flux being supported on said entrance portion and said molten coating metal being supported on said exit portion, and applying heat to said bath of molten supporting metal to provide a temperature in said entrance portion substantially between 600 and 850° F. and to provide a temperature in said exit portion and in the molten coating metal supported thereby of at least substantially 1200° F. said molten coating metal being of a class consisting of aluminum and its alloys, and said molten supporting metal comprising lead.

Deposition of Metal on Glass from Metal Formates

U. S. Patent 2,430,520. *Evelyn C. Marboe, assignor to Glass Science, Inc.*

The method of forming adherent metal deposits on glass which comprises volatilizing a metal formate in vacuo and causing the vapors to come into contact with hot glass surfaces in vacuo heated to a sufficiently high temperature to effect decomposition of the formate and form an adherent metal deposit on the glass surface.

Mineral Oil Rustproofing Composition

U. S. Patent 2,430,058. *Joseph H. Klaber, assignor to Quaker Chemical Products Corp.*

A mineral oil rustproofing composition comprising a petroleum hydrocarbon vehicle containing a corrosion inhibiting amount of a mixture of a mono-ketone having a long alkyl chain and octyl alcohol the alcohol being present in greater amount than the ketone.

Method of Electroforming of Metals

U. S. Patent 2,430,092. *Axel Westin.*

In the electric forming of a metallic member in electrode dies which simultaneously heat and form the member, the conduction of heating current between the dies and member through a lubricant containing graphite, and the carrying of the lubricant on the member by the addition thereto of sulphur and sodium chloride which melt at different temperatures in the operation to provide a molten vehicle for the graphite,

Anodizing Iron Group Metals in Lead Sulfamate Bath

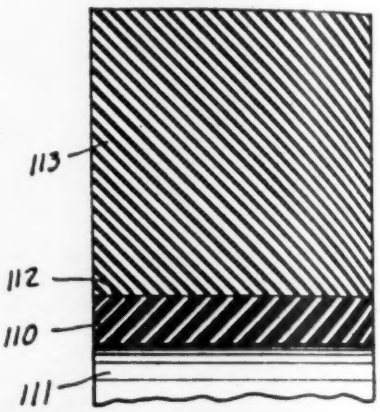
U. S. Patent 2,430,304. *Ernest W. Schweikher, assignor to E. I. du Pont de Nemours & Co.*

In a process for producing coatings upon iron group metals, the step comprising electrolyzing an iron group metal anodically in a solution having a pH of about from 4.2 to 5.9 and containing about from 75 to 450 grams per liter of lead sulfamate.

Expanding Head for Abrasives

U. S. Patent 2,432,731. *Oliver S. De Haven, assignor to Vonnegut Moulder Corp.*

An expanding head for abrasive bands comprising a core of dense rubber, and an annular outer expansible



body portion of rubber having a degree of stretch, said outer body portion surrounding said core and being bonded thereto at a predetermined radial distance inwardly from the outer periphery of the head to limit the expansion thereof to the stretch of said body portion.

Electrodeposition of Nickel-Tungsten Alloys

U. S. Patent 2,432,893. *Matthew Leslie Holt, and Morris L. Neilsen, assignors to P. R. Mallory & Co., Inc.*

In the art of electrodepositing a nickel tungsten alloy, the steps which consist in passing current between an anode and a cathode through a modified Watts bath containing nickel sulfate, nickel chloride, boric acid, and sodium tungstate, maintaining the sodium tungstate content of the bath at such a value as to provide a tungsten concentration within the range of 0.2 to 16.0 grams per liter, operating the bath at a pH within the range of 2.0 to 5.4, and controlling the tungsten concentration and pH so as to produce a metallic deposit.

Plating Room Health Hazards

While plating and finishing operations are carried out with complete safety and surprisingly few serious accidents, it is nevertheless one of the first duties of supervisors to properly instruct both old and new employees in the potential hazards of the materials they are working with, and to insist upon safe practices at all times. The following information can be used as a brief for such instruction.

Vapor Degreasing

The chlorinated hydrocarbons used for vapor degreasing operations (trichlorethylene and perchlorethylene) will cause dizziness and nausea if the vapors are inhaled in sufficient amounts, and may result in loss of consciousness. The vapors are non-inflammable under ordinary conditions. Severe burns may result if the operator thrusts his hands below the vapor level, as the oil is rapidly extracted from the skin. Excessive contamination of the atmosphere can be avoided by proper operation, and completely enclosed machines are available for high production work.

Alkaline Cleaning

Vapors and mists arising from these solutions carry some of the alkali with them, which causes irritation of the nasal passages and eyes. Strong boiling solutions can also cause severe burns. Many types of cleaners produce some foam, which aids in keeping vapors from rising into the surrounding atmosphere.

Pickling, Bright Dipping, Passivating

The strong acid solutions used in these processes should only be handled with proper safety clothing. The brown fumes from nitric acid solutions are very poisonous. Besides destroying clothing on which these acids are spilled, the fumes are very corrosive to equipment in the immediate vicinity. Excessive exposure to strong acid fumes may cause dental decay to become abnormal.

Chrome Plating and Anodizing

Chromic acid mists may produce ulcerations of the nose and throat. The solutions are also very destructive to clothing. Chrome holes (skin ulcerations) may develop on hands and arms not protected by gloves or skin creams. Bath covering materials and mist suppressors provide effective control measures.

Cyanide Solutions

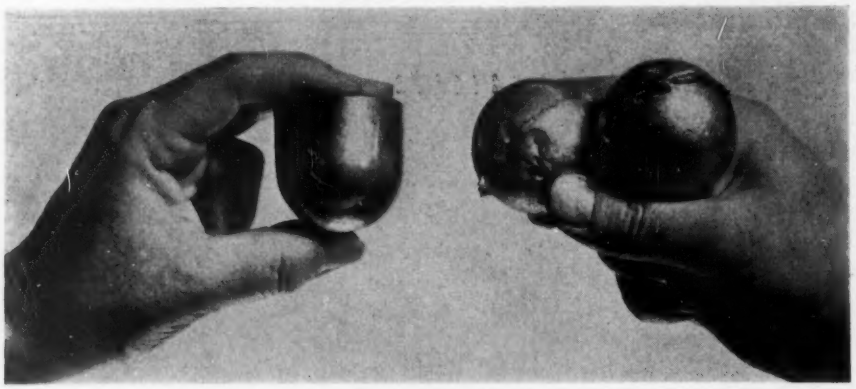
The cyanides constitute a class of the most powerful poisons known. Small amounts accidentally splashed into the mouth may prove fatal. Cyanides may also be absorbed through the skin. Acids introduced into cyanide solutions will cause the deadly hydrocyanic acid gas to be liberated. Extreme care should be exercised at all times when working with cyanide solutions.

General Remarks

Efficient exhaust and ventilation should always be provided for all process tanks, including hot water tanks. While this will take care of most fumes and mists, the avoidance of direct contact with the solutions will depend entirely on the care exercised by the operators.

Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries



Zinc Anodes

Wagner Bros, Inc., Dept K, 418 Midland Ave., Detroit 3, Mich.

A new form of zinc anode, destined to solve some of the common problems in electroplating, has been introduced and is now being manufactured by the above firm. Known by the copyrighted name of "Flat Top" because of its shape, the anode is so distinctive in appearance as to prevent accidental confusion with cadmium or tin ball anodes, thus avoiding mixing of plating solutions and the consequent loss of time and materials from shut-downs and dumping of plating tanks.

The Flat Top shape is retained throughout the plating process, so that a glance at the anode basket will identify the zinc tank. The anode's smooth surface is free from gates and flash which frequently cause ball anodes to hang on the basket wires, and the effective plating area is from 20% to 25% greater than a ball of like diameter, it is claimed. The greater weight per anode reduces loading frequency. According to the manufacturers, the zinc is 99.99% pure, the highest purity available.

Another Flat Top innovation is the new wooden keg container which is sealed against contamination. The standard package is 250 pounds. Price structure is the same as for ball anodes. For further details, write for attractive new four-page folder.

Removable Plastic Coating

Watson-Standard Co., Dept. MF, 225 Galveston Ave., Pittsburgh, Pa.

Peelcote, a new protective coating for metal parts which can be easily and quickly peeled off after it has served its purpose, has been developed by the above concern.

It is an air-drying coating designed to protect from scratches, chips and corrosion during shipment, storage, handling and some types of fabrication. It can be applied by spray or dip methods and dries quickly. It is removed quickly and cleanly simply by pulling it off. Peelcote is a vinyl-based coating with complete chemical inertness. It is available in clear transparent or solid hiding black.

Foam Blanket Chips

Industrial Lining Engineers, Inc., Dept. MF, Sewickley, Pa.

The above company announces a new flat plastic chip for suppression of foam in all types of aqueous solutions or baths. The chips float on the surface of the solution thereby reducing the exposed solution surface, and by their motion mechanically destroy foam as it is formed. The mobile blanket so formed will readily part to permit work to be introduced or withdrawn from the bath, it is claimed. Will not retard evaporation, but will materially reduce foaming, frothing, priming difficulties, also reduces spray losses, according to the company.

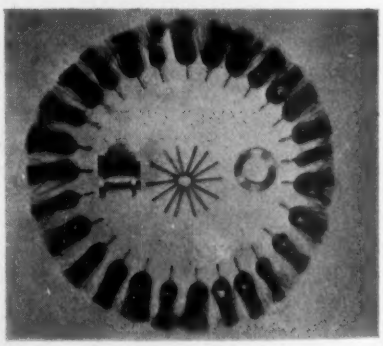
Steel Wire Tufts for Satin Finish Hanger Brushes

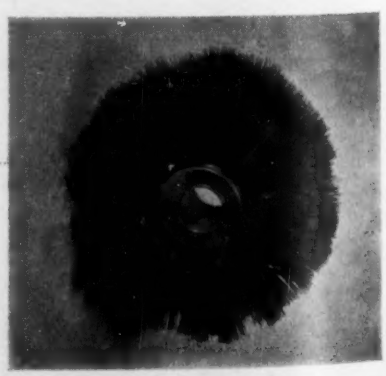
The Hanson-Van Winkle-Munning Company, Dept. MF, Matawan, N. J.

Announcement of an improvement in their satin finish hanger brushes has been made by the above firm. Each tuft will now be supplied with an S-hook, properly attached. These hooks provide the swing action required for a smooth satin finish.

To keep the wire tuft in the most effective operating condition, occasionally reverse the brush on the spindle.

The tufts for satin finish brushes are mounted on rods which are parallel to the axis of the hub. Formerly the user had first to open one end of the S-hook, slide it through the eye of the tuft, and then close the S-hook wih a pair of pliers in order to be sure that there was a good tight connection between the S-hook and the tuft. This was a tedious chore; also it took the time of





good operators who might have put it to good use doing satin finishing instead of assembling tufts and hooks, to replace the worn tufts on their satin finish brushes.

Now that these brushes are supplied with the S-hook properly attached, this loss of time will be eliminated and production increased, it is claimed.

New Industrial pH Meter

The Macbeth Corporation, Dept. MF, 227 West 17th Street, New York 11, N. Y.

The new Macbeth Industrial pH Meter, latest in a series of line oper-

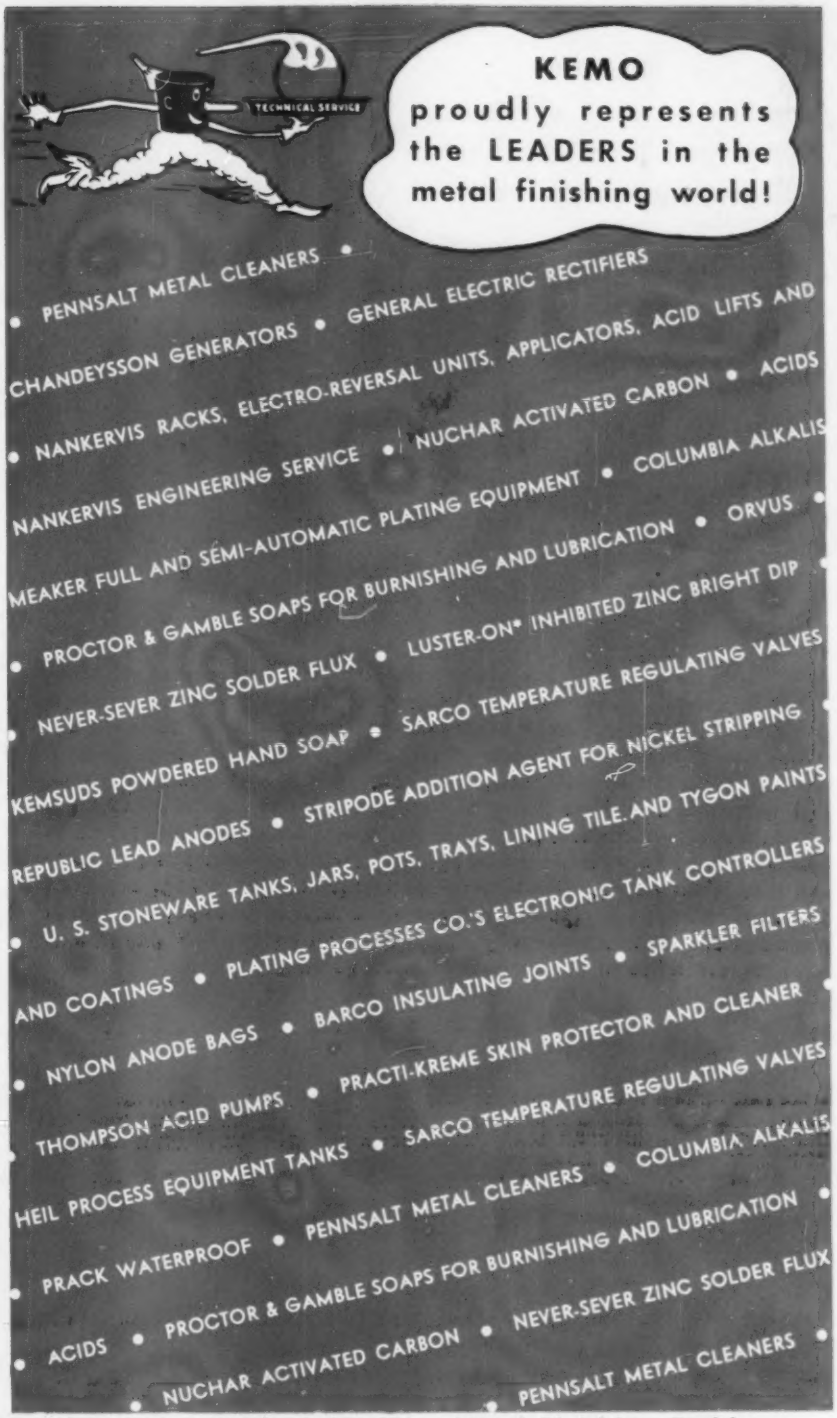
ated, direct reading, continuous indicating, pH Meters, includes two stages of voltage regulation, permitting voltage variations from 80-135 volts, to eliminate difficulties arising out of widely varying factory voltages.

The electrical circuit of the new Macbeth Industrial pH Meter has been completely freed from grounding so that the electrodes may be used in grounded tanks or flow lines, it is claimed. This instrument may be used for controlling and recording. Further information may be had by writing the Macbeth Corporation.

Wire and Tampico Brushes

C. W. Morris Co., 10629 *Cloverdale Ave., Dept. MF, Detroit, Mich.*

Announcement is made by the above


TECHNICAL SERVICE
KEMO
proudly represents
the LEADERS in the
metal finishing world!
• PENNSALT METAL CLEANERS •
CHANDEYSSON GENERATORS • GENERAL ELECTRIC RECTIFIERS
• NANKERVIS RACKS, ELECTRO-REVERSAL UNITS, APPLICATORS, ACID LIFTS AND
NANKERVIS ENGINEERING SERVICE • NUCHAR ACTIVATED CARBON • ACIDS
MEAKER FULL AND SEMI-AUTOMATIC PLATING EQUIPMENT • COLUMBIA ALKALIS
• PROCTOR & GAMBLE SOAPS FOR BURNISHING AND LUBRICATION • ORVUS •
• NEVER-SEVER ZINC SOLDER FLUX • LUSTER-ON* INHIBITED ZINC BRIGHT DIP •
KEMSUDS POWDERED HAND SOAP • SARCO TEMPERATURE REGULATING VALVES
REPUBLIC LEAD ANODES • STRIPODE ADDITION AGENT FOR NICKEL STRIPPING
• U. S. STONEWARE TANKS, JARS, POTS, TRAYS, LINING TILE AND TYGON PAINTS
AND COATINGS • PLATING PROCESSES CO.'S ELECTRONIC TANK CONTROLLERS
• NYLON ANODE BAGS • BARCO INSULATING JOINTS • SPARKLER FILTERS
THOMPSON ACID PUMPS • PRACTI-KREME SKIN PROTECTOR AND CLEANER •
HEIL PROCESS EQUIPMENT TANKS • SARCO TEMPERATURE REGULATING VALVES
PRACK WATERPROOF • PENNSALT METAL CLEANERS • COLUMBIA ALKALIS
• ACIDS • PROCTOR & GAMBLE SOAPS FOR BURNISHING AND LUBRICATION •
• NUCHAR ACTIVATED CARBON • NEVER-SEVER ZINC SOLDER FLUX
• PENNSALT METAL CLEANERS •

Let "Kemo" Help Solve Your Metal-Finishing Problems

Now that our lines include the quality products of the nation's leading manufacturers in the metal-finishing field, we can offer better technical service than ever before.

Our salesmen are well trained to solve your problems or find the answers for you. Please call on them freely at any time.

82 *REG. U. S. PATENT OFFICE

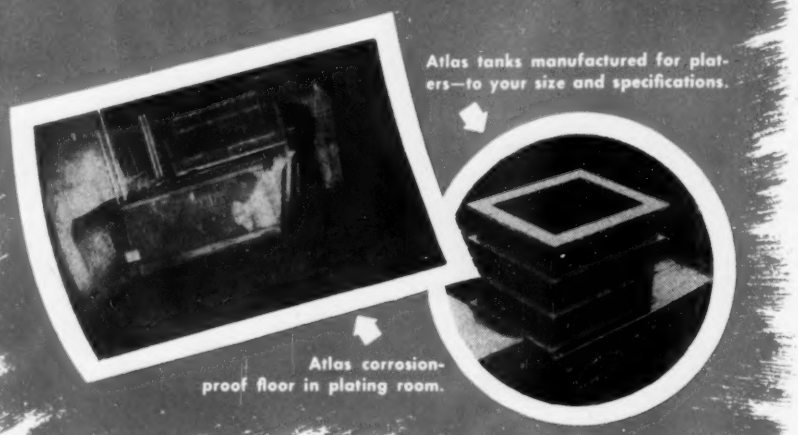
THE Chemical CORPORATION

54 Waltham Ave., Springfield 9, Mass.

THE CHEMICAL CORPORATION
54 Waltham Ave., Springfield, Mass.
Please have your representative call to talk over our metal-finishing needs.
Name_____
Firm_____
Address_____

METAL FINISHING—MARCH

CORROSION-PROOF *Tanks and Floors*
That take NO "DOWN TIME"



Tanks and Floors of Atlas design and Atlas corrosion-proof materials: cements, plastic linings, jointing materials and protective coatings—serve without time off for repair and maintenance • In addition to being *proof against*—not merely "resistant to" acids, alkalis, corrosive salts and solvents, Atlas construction withstands water, steam and high temperatures • Atlas Dual Construction (patented) cuts time and labor costs, speeds units into service and permits operation at temperatures up to 360° F. • Atlas Floors stay smooth, develop no corrosion ruts or high spots—and they withstand heavy traffic and mechanical impact • Atlas engineers are ready to study your special problem, make recommendations and submit plans and estimates—without obligation • Write for Bulletin T3-D and contact Atlas representative at nearest branch listed below.

The *Atlas Mineral* *Products Company of Penna.*

THE ATLAS MINERAL PRODUCTS CO. OF TEXAS INC., Box 252, Houston 1, Texas

*BERKELEY 2, Calif., 603 Addison St. *OMAHA, Neb., 423 South 38th Ave.
BALLAS 5, Tex., 3921 Purdue St. *LOS ANGELES 12, Calif., 172 S. Central Ave.
*DENVER 2, Colo., 1921 Blake St. *SEATTLE 4, Wash., 1252 First Avenue, S.
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MERTZTOWN
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NEW YORK 16, N. Y., 280 Madison Ave.

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PITTSBURGH 27, Pa., 4921 Plymouth Rd.
PHILADELPHIA, Pa., 535 Fairview Rd. Springfield, Pa.
ST. LOUIS 8, Mo., 4485 Olive St.

IN CANADA: Atlas Products are manufactured by H. L. BLACHFORD, Limited, 977 Aqueduct Street, Montreal, P. Q., 86 Bloor St. W., Toronto, Ont.

firm of a complete line of wire and tampico power brushes for the metal finishing industry. These wire brushes are made of special analysis wire which has been proven best for this type of use, and the construction has been designed to guarantee long life under the most severe service conditions.

General purpose wire wheels are available in sizes from 4-15 inches in diameter, faces from 1-3 inches in width, with wire diameters .0118-.0140. Superba wire sections are made in the same wheel diameters, with ½ inch faces, and wire sizes from .008-.014.

Tampico brushes are specially constructed, to eliminate shedding, by the ring-lock method developed by this firm, and are available either treated or un-treated in sizes from 6-14 inches, ½ inch face.

All brushes are supplied with arbor holes to the customers specifications, and with centers and adapters as required.

Corrosion Resistant Equipment

General Ceramics & Steatite Corp., Dept. MF, Chemical Equipment Division, Keasbey, N. J.

Impervious Graphite corrosion proof equipment has been added to the company's line of process apparatus. A full line of apparatus consisting of plate heaters, seven tube heat exchangers, bayonet heaters and pipe and fittings will be carried.

This equipment is impervious to the corrosion of most strong acids and alkalies and has a high resistance to thermal shock and a high overall thermal conductivity. This makes it useful for many heat transfer problems including corrosive materials. Specific applications are: heating of pickling tanks, heating and cooling of plating solutions, condensing corrosive vapors, evaporating acid solutions, and absorption of HCl vapors to produce muriatic acid.

This equipment will be offered both in combination with chemical stoneware and porcelain apparatus to provide a complete corrosion proof installation for the above services and separately where accessory equipment is not required. A six page bulletin with descriptions and dimensions of all apparatus is available and will be sent on request to the company's New Jersey address.

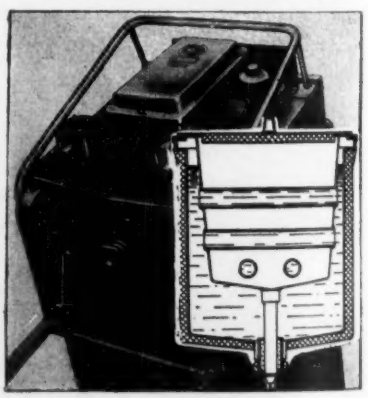
Indirectly Heated Dispensing Tanks

Aeroil Products, 57th St. & Park Ave., West New York, N. J. Dept. MF.

Two new indirectly heated, thermostatically controlled, melting and dispensing tanks with new type indirectly heated dispensing valves have just been announced by the above firm.

These new units, it is claimed, eliminate over 90% of the causes for production stoppages in melting and dispensing battery and transformer compounds, critical waxes, and similar materials.

The manufacturer states that because the heat comes into the compound uniformly at the same controlled



temperature from every square inch of the inner surface of the inner vat of the double boiler arrangement, it is impossible to "coke" or char the material being heated.

Both units are built on the double boiler principle and feature a patented

series of oil carrying tubes that run through the length and width of the inner vat so as to bring the same thermostatically controlled indirect heating from within the melting compound, itself.

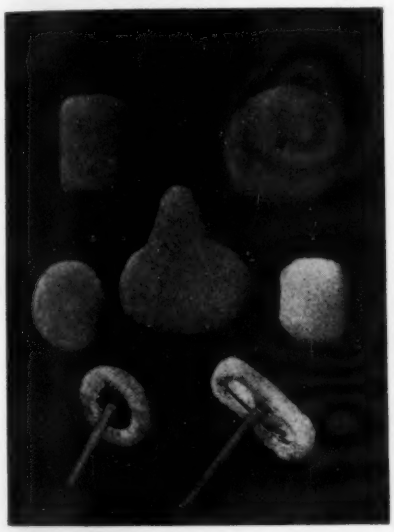
In addition, the same thermostatically controlled oil bath is used to heat a new type of poppet action dispensing valve that, it is claimed, cannot freeze or drip.

Both gas-fired and electrically heated equipment is available. Both are fully insulated and heated from the inside to minimize heat losses. Leaflet No. 603-P available on request.

Polishing Discs and Bonnets

Henderson & Austin, Inc., 308 *Atlantic St., Stamford, Conn., Dept. MF.*

Announcement is made of a line of lambs wool products—polishing bonnets and discs, waxers, polishing mitts,



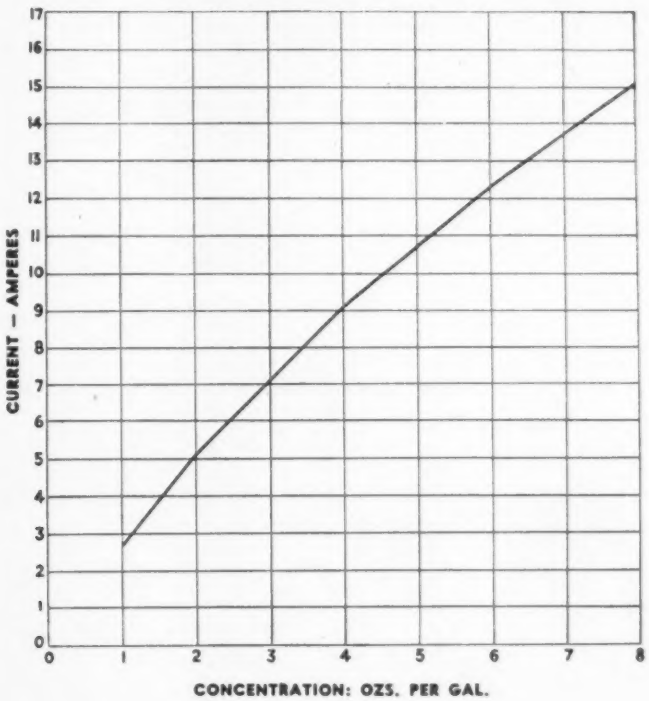
Lambsponge, chamois, and other lambswool products.

Polishing bonnets and discs (for automatics) are claimed to be tough and long-wearing, standing up under repeated wetting and drying friction heat, and repeated cleaning without matting, cracking, distorting or hardening.

Red Dot polishing mitts are large popular size, 9¼" x 6½", with special internal seam sewing for rip-proof long life and with no edges or sharp seams to mar or scratch highly polished surfaces, it is claimed. Fits hand snugly with heavy wristlet of *knit* elastic webbing. Used for fine polishing as well as heavy-duty washing or scrubbing. Washes easily when soiled, retaining original softness and freshness.

For faster cleaning of ferrous parts— WYANDOTTE F.S.

Current-conducting Characteristics of Wyandotte F.S.
(Steel Electrodes, 6 Volts, 180° F.)



Wyandotte F.S. is a heavy-duty reverse-current electrocleaner, especially designed to remove fabricating compounds and "smut" from ferrous parts prior to plating.

Because F.S. is a *balanced* formulation, it assures (1) high conductivity—see chart above, (2) fast and complete wetting and cleaning action, (3) controlled foaming and (4) long life in solution.

Your Wyandotte Representative will be glad to demonstrate the advantages of Wyandotte F.S. or any other Wyandotte Metal Cleaner at your convenience. He's always at your service.

Wyandotte
REG. U. S. PAT. OFF.

WYANDOTTE CHEMICALS CORPORATION
WYANDOTTE, MICHIGAN • SERVICE REPRESENTATIVES IN 88 CITIES

Filter All Plating Solutions Faster, More Completely in

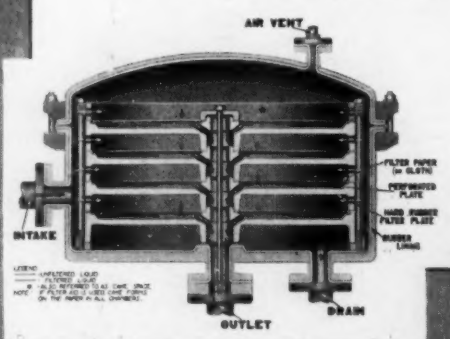
SPARKLER *Horizontal Plate* FILTERS

Because the filter cake is held horizontally, it is absolutely stable to the end of each filtering cycle. And cycles are longer because the cake retains its porosity longer. That is why the "horizontal principle," as embodied in Sparkler filters, gives you more efficient, low cost, operation. Sparkler filters are pressure-tight and leak-proof, designed for intermittent or continuous operation.

4 Plating Solution Types

1. Rubber-lined for bright nickel
2. Stainless steel for acids
3. All Iron for alkaline solutions
4. All Steel (with Stainless Pump) for chromium

SPARKLER MANUFACTURING CO.
Mundelein, Illinois



Made in Capacities
60 to 10,000 G.P.H.

See your supplier or Write for details

Our Engineering Service is available for any specialized problems.

Spray Eliminator for Pickling

Hanson-Van Winkle-Munning Co., Dept. MF, Matawan, N. J.

Surbrite Foam is a product to be used when very heavy pickling operations are being carried out. Pickling inhibitors or "steel surface conditioners" do not completely eliminate the formation of hydrogen. Consequently, in very heavy pickling operations a considerable amount of spray may be produced.

This material, when added to the pickle bath, will produce a foam which will blanket the solution and prevent the escape of spray from the bath, it is claimed.

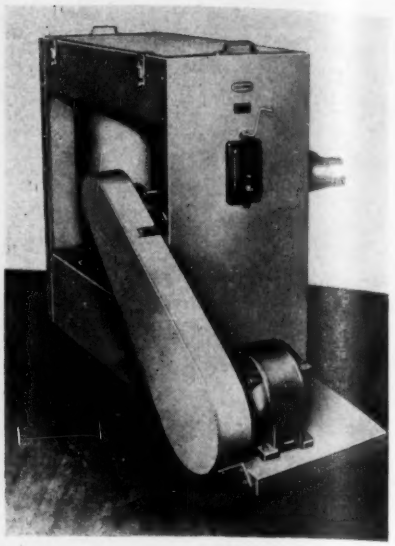
Surbrite Foam is a dry powder which must be added daily to the pickling tank. The usual addition consists of 1 pint per 100 square feet of bath surface daily, but this, of course, will depend upon the amount and type of work being processed and should be modified by the pickle house foreman to suit his requirements, according to the above firm.

High Capacity Dust Collector Now Available for 25 Cycle Operation

Aget-Detroit Company, Ann Arbor, Mich., Dept. MF.

Model 11D50 Dustkop for operation on 25 cycle power is added to its line of industrial type self-contained dust collectors by the above firm.

A modification of the standard Model 1150 collector, the new model incorporates the use of a special motor



mounting for an overdrive so that the normal fan speed will be maintained even though operated on 25 cycle power. This permits the equipment to develop in excess of 1300 cfm suction on a 6 inch diameter inlet (600 cfm on double 4" inlets) with 3" water lift.

The dust removed by suction, first passes through a cyclone separator, which separates a large percentage of all dusts. These are all deposited in a drawer, readily removed from the end of the collector.

The partially cleaned air then rises through the cyclone separator and receives a second stage cleaning by means of a spun glass (firesafe) filter.

The spun glass filter material comprising the top of the unit is contained in an expanded metal frame and is easily renewable. On average production grinding and polishing operations the filter requires renewal at not greater than once every two months according to the manufacturer. A shaker handle extending from the side of the unit permits regular shakedown of the filter to prolong its useful life.

The floor space required by the unit is 22" x 53½", and the overall height is 42".

Larger Porous Stainless Steel Filter Sheets

Micro Metallic Corp., 193 *Bradford St., Brooklyn 7, N. Y., Dept. MF.*

As the result of a newly developed butt welding technique, it is now possible to join together 6" x 18" unit sheets of porous stainless steel to form large sheets of any required area. A modified form of inert gas shielded tungsten arc welding is used. The new welding

technique is particularly applicable in making up large sheets when the filter material is 0.100" or more thick. Many types of special shapes can be welded from 1/16" thick material. The welds are strong and ductile.

In addition to producing filter sheets of any area, the company claims to be able to weld the porous material to solid stainless steel members, such as enclosing rings, flanges, etc. The weld assembled sheets can be sheared, drilled and machined; within limitations they can be subjected to rolling and drawing operations; and they can be welded again after machining and forming.

D.C. Rectifier

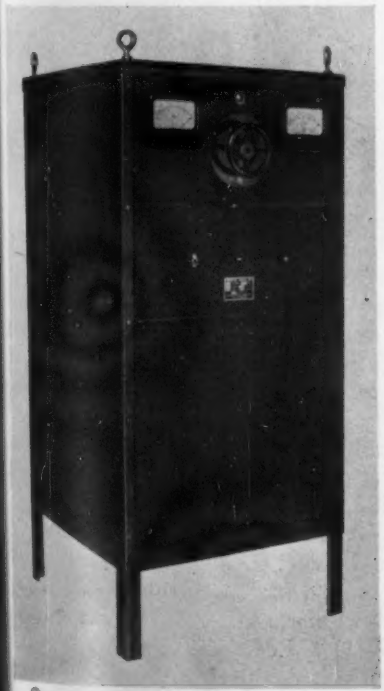
Mellaphone Electronic Rectifier Co., Inc., Dept. MF, Rochester, N. Y.

A new line of low voltage high current rectifiers is now available for operation from 220 or 440 volts three phase A. C. power lines. D. C. output voltage can be varied from 0 to 6 volts, with a capacity of 600 amperes, or from 0 to 12 volts with a capacity of 300 amperes.

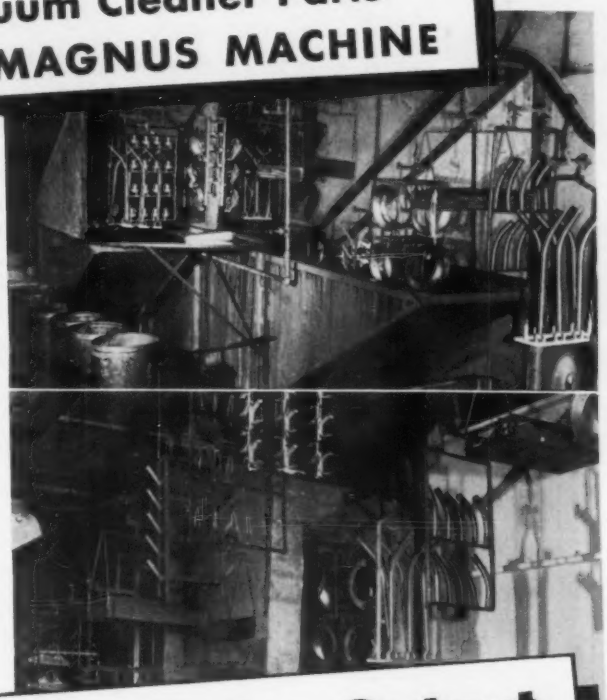
Although primarily intended for use in electro-plating and electrolytic cleaning, these rectifiers provide an ideal source of power for production testing, and running in, of 6 volt and 12 volt D. C. motors, etc.

Features of these new rectifiers are:

1. Selenium rectifier elements, thoroughly sealed, providing high efficiency, unlimited life,



Seven Stages of Cleaning For Vacuum Cleaner Parts In this MAGNUS MACHINE



Stage 1 . . . Precleaning

Stage 7 . . . Drying

DOUBLE the Output with HALF the Labor

THIS multi-stage, special cleaning machine was designed to handle the 412 component parts of a famous vacuum cleaner, replacing hand cleaning operations which required eight men. The machine, with four men, turns out twice as much work. Cleaning that used to take 1¾ hours is done in five minutes!

Parts go through the machine on an overhead conveyor. In Stage 1 they are precleaned in Magnusol (the Emulso-Dip Process). Stage 2 drains the parts. At Stage 3, a 40 lb. cold water spray knocks off loosened dirt, grease and oil, readying the parts for spray washing with a mild Magnus alkaline cleaner in Stage 4. Stage 5 provides a hot water spray rinse, followed by Stage 6, a cold air blast to remove clinging water particles. Stage 7 is a final drying operation at 200° F. Parts are then ready for finishing.

The Magnus line of metal cleaning machines includes both standard batch units and specially designed machines to fit into the production line.

MAGNUS CHEMICAL COMPANY
11 South Ave., Garwood, N. J.
IN CANADA – MAGNUS CHEMICALS, LTD., 4040 Rue Masson, Montreal 36, Que.
Service representatives in principal cities.

IN METAL CLEANING IT'S
Magnus
CLEANERS • EQUIPMENT • METHODS

THERE'S A DETREX MACHINE *for Every* METAL-CLEANING APPLICATION

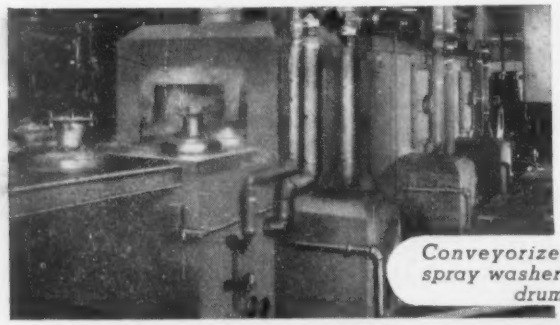
Cleaning small parts in a hand-operated degreaser.

DETREX builds all sizes of hand-operated and conveyorized degreasers and washers for cleaning every kind of metal parts . . . ranging from needles to auto bodies — and with any production volume desired. Work handled includes castings, forgings, tubing, wire and stampings — both of ferrous and non-ferrous metals.

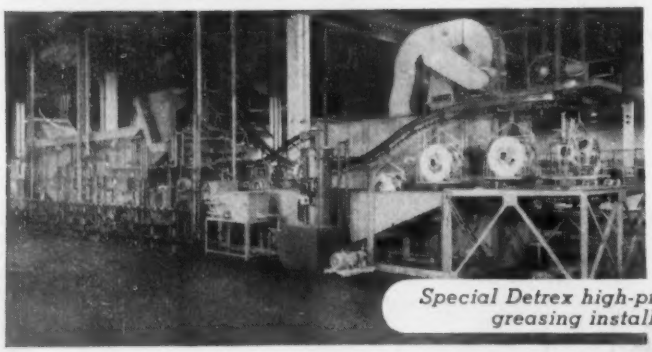
For most jobs, *standard* Detrex machines provide top speed and economy, either used "as is" or with minor modifications. For the really unusual jobs, special machines are designed and built to assure the same top efficiency.

Detrex also supplies the solvent or cleaning compound needed to obtain maximum performance from each machine and top efficiency on *every* metal-cleaning application.

In all cases, the machines and cleaning compounds are backed by a nationwide field organization. Consult your Detrex field representative.



Conveyorized three-stage alkali spray washer cleaning truck brake drum assemblies.



Special Detrex high-production degreasing installation.

Degreasing Machines and Safety Solvents • Metal Parts Washers • Alkali and Emulsion Cleaners and Strippers • Processing Equipment • Spray Booth Compounds

SA 3-48

DETREX Corporation

DETROIT 32, MICHIGAN

quiet operation, and good voltage regulation.

2. Heavy duty variable voltage transformer provides smooth stepless control over output voltages, from zero to maximum setting.
3. Each unit is complete and includes large 4½" ammeter and voltmeter and protection against over-loads and failure of ventilation system.
4. These rectifiers are conservatively designed, and will withstand a considerable degree of over-loading without danger of over-heating either the transformers or rectifier stacks, it is claimed.

Utility Fan

Chelsea Fan & Blower Co., 1206 Grove St., Irvington 11, *N. J., Dept. MF.*

This newly designed fan of sturdy construction is used for equalizing temperature and humidity, for drying and cooling. The totally enclosed motor

is equipped with ball bearings so that this type fan can be operated in any position. It can be floor mounted without additional support, or can be suspended at any location and at any angle in order to direct the air flow in any desired direction. Blades are all steel, die stamped and die formed. It is equipped with safety guards, front and back, and an extension cord and plug, making it a convenient portable fan. Available in two convenient sizes: the AA 20" fan delivers 3,000 C.F.M., and the AA 24" fan delivers 4,800 C. F. M.

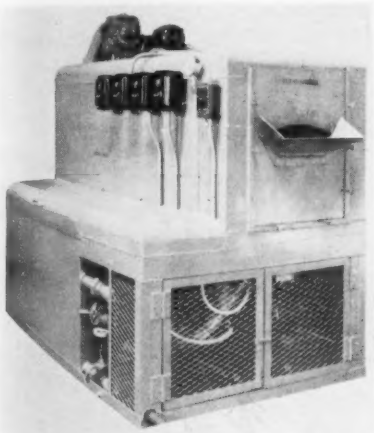
Drum Type Washing Machines

Metal-Clean Solvent Corp., Industrial Washing Mach. Div., Dept. MF, Chicago, Ill.

Announcement is made of three new space-saving, continuous rotary drum type washing units.

The smallest of these is a continuous spiral rotary drum type washing unit three and one-half feet long. The next size is a wash and dry machine six feet long, and the largest wash unit produced by this company is a wash, rinse, and dry unit, nine feet long.

The Industrial Washing Machine Division states that these units are built to process seven hundred to nine hundred pounds of small metal stampings



or screw machine parts per hour, that they are completely automatic in their operation, and are designed and built for easy maintenance and cleanouts.

The company claims that the units are made of the highest quality materials and can be used by any firm producing batches of material or continuous flow.

It is also claimed that these units are the most compact of their kind, yet produce more pounds of work per hour, per capital investment, than any other machines of their type on the market.

Dust Collector

Pulverizing Mach. Co., 214 Chatham Rd., Summit, N. J. Dept. MF.

A new dust collector, claimed to be the first commercially successful application of hard-pressed wool felt as a filter medium in industrial air and gas filtration, has been announced by the above firm. In the *Mikro-Collector* the problem of clogging of the felt

CHROMIC ACID

99.75% PURE

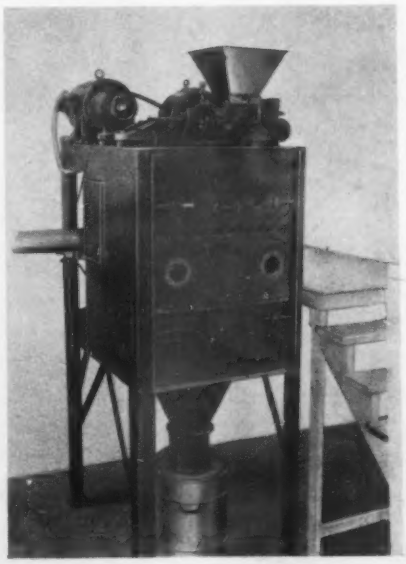
With two complete, independent plants at Jersey City and Baltimore, and over a hundred years of technical background, Mutual is the world's foremost manufacturer of Chromic Acid.

MUTUAL CHEMICAL CO. NEW YORK

OVER A CENTURY OF CHROMIUM CHEMICAL PROGRESS

Bichromate of Soda
Bichromate of Potash

MUTUAL CHEMICAL COMPANY OF AMERICA
270 MADISON AVENUE NEW YORK 16, N.Y.



pores has been solved by the use of a hollow, annular blow ring which hugs and flexes the cylindrical felt bag while moving up and down its outer surface by means of conventional chain and sprocket drive.

Around the inner periphery of the blow ring is a narrow slit through which is directed a jet of air supplied by a positive pressure blower. This counter-current of air is conveyed to the blow ring by a flexible hose and assures a perpetually clean bag. During the filtering operations no portion of the filter surface need be cut off for cleaning or shaking.

The manufacturers claim 99.99 per cent recovery of most solids.

Another important claim made for

W. J. HOLTMEIER

formerly Eastern Manager for

Hammond Machinery Builders, Inc.

announces the formation of the firm of

W. J. HOLTMEIER, INC.

71 WEST 23RD STREET, NEW YORK 10, N. Y.

(PHONE: GRAMERCY 5-8252)

Specializing in the sale of

Grinding—Polishing—Buffing and

Abrasive Belt Machinery

ABRASIVE MACHINERY
GRINDING · POLISHING
BUFFING & ABRASIVE
BELT MACHINERY
REG U.S. PAT OFF

the *Mikro-Collector*, is the ability to handle dusts containing a high percentage of moisture or oil.

Tumbling Barrel

D. J. Murray Mfg. Co., Wasan, Wisc. Dept. MF.

Designed with streamlined appearance, the new Murco tumbling barrel has features of interest to manufacturers that deburr, burnish, clean, polish and smooth-surface metal and plastic parts on a mass production basis. Compact, the barrel is simply designed for low maintenance. Speed changes may be made while the barrel is in motion, giving a wide range of speeds to meet various operating conditions and requirements. Specially designed dump

pans are mounted on casters, and are provided with bail handle notched for crane hook. The discharge end of pan is funnel shaped, which fits in the compartment opening to facilitate loading. Separating screens of various mesh wire can be mounted in frames to fit dump pans. All moving parts such as the barrel, gears, pulleys and motor, are protected with guard rail, steel enclosures, and concealed design for safety of operation. While the frame and barrel are light weight they are claimed to withstand heavy duty service.

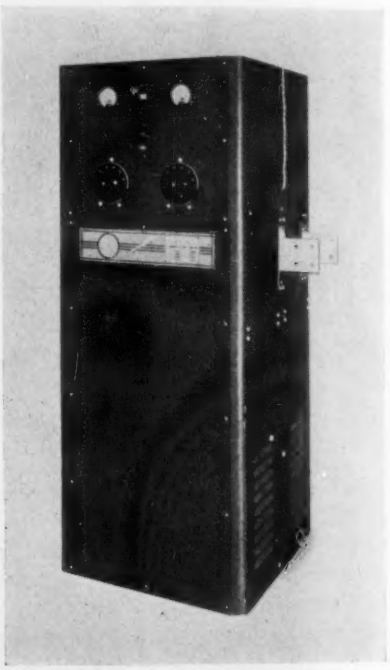
Further information may be obtained on this equipment by writing to the manufacturer on your company letterhead.

New 36 Position Tap Switch on Selenium Rectifier Line

Richardson-Allen Corp., Dept. MF, 15 W. 20th St., N. Y. C.

A new series of Selenium Rectifiers with 36 position tap switch controls has been announced by the above firm as an addition to their line.

These tap switches, though they do not offer the perfect minute settings



possible with the Step-less Variable Controls which Richardson-Allen also features, do offer a very definite economy in original purchase that is advantageous to those who do not need extremely fine settings.

Standard units are designed generally for 36 position voltage taps (6 coarse, 6 fine) with two controls. Finer voltage steps for 60 or 100 tap positions are available to meet special requirements.

These units include voltmeter, am-

meter with shunt, 5,000 hour pilot light, start and stop push buttons and are standard up to 27 KW capacity. Special units are available for higher KW requirements.

Polishing Speed Lathe

Schauer Mach. Co., Dept. MF, Reading Road, Cincinnatti 2, O.

Providing a unique and advanced method for polishing and finishing stainless steel, copper and aluminum bowls, discs, plates, reflectors, etc., this

new Schauer Speed Lathe, with vacuum-type holding fixtures, makes possible the speedy, simultaneous polishing of the entire surface of the object, with an evenness of lustre than cannot be equaled, it is claimed. With this machine, *the part is revolved*, instead of bringing it up to a revolving abrasive or polishing wheel. The part is held in the fixture by vacuum. Various types and sizes of vacuum holding fixtures may be provided, depending upon the size and shape of the parts to be finished. This type of fixture will not mar nor distort the part, even though the latter may be very thin, according to the manufacturer. The machine is equipped for hand operation of motor and brake control, and with hand air valve. It can also be arranged for foot treadle operation. The brake is applied automatically the instant the power supply to the motor is cut off. Braking is of velvety smoothness, stopping the motor in two second at high speed, and in one second at low, factors which contribute to the machine's high rate of production.

COATING-TIME CUT IN HALF!

...with the New, 100%-Solids Unichrome Coating 218

FIVE HUNDRED RACKS were coated with 218 in half the time usually spent with solvent types—that's the report from a big user of Unichrome Coating 218.

How are such huge savings possible? Because fewer coats are needed. You use only one main coat of 218 over a prime and "tie" coat—the entire job taking about 2 hours.

And not only is this coating *quicker* to apply, it also *lasts longer*. For Unichrome Coating 218 cures to a smooth, elastic, thick jacket that resists all plating and cleaning baths, and won't chip or tear. It will pay you learn more about it. Write today.

(Ask us for the name of a local applicator who will coat your racks with 218 if you don't have a baking oven.)

SEND FOR THIS BULLETIN, which explains how to save time and money in insulating your racks.

UNICHROME

Trade Mark Reg. U.S. Pat. Off.

RACK COATINGS—Products of
UNITED CHROMIUM, INCORPORATED • 51 E. 42nd St., New York 17, N.Y.
Detroit 7, Mich. • Waterbury 90, Conn. • Chicago 4, Ill. • Dayton 2, Ohio • Los Angeles 13, Cal.

9 Volt Rectifier

Bart-Messing Corp., 45 Morgan Ave., Dept. MF, Brooklyn, N. Y.

A new 9 volt, 2,500 ampere selenium rectifier has just been introduced by the above company. This unit was primarily designed to permit a reserve of voltage for platers desiring to use diluted solutions of chromic acid or other baths to conserve their limited supplies of critical materials.

Installations made in several large plants have verified the claims of the manufacturer that the quality of plating of a diluted solution has not affected the quality of the work.

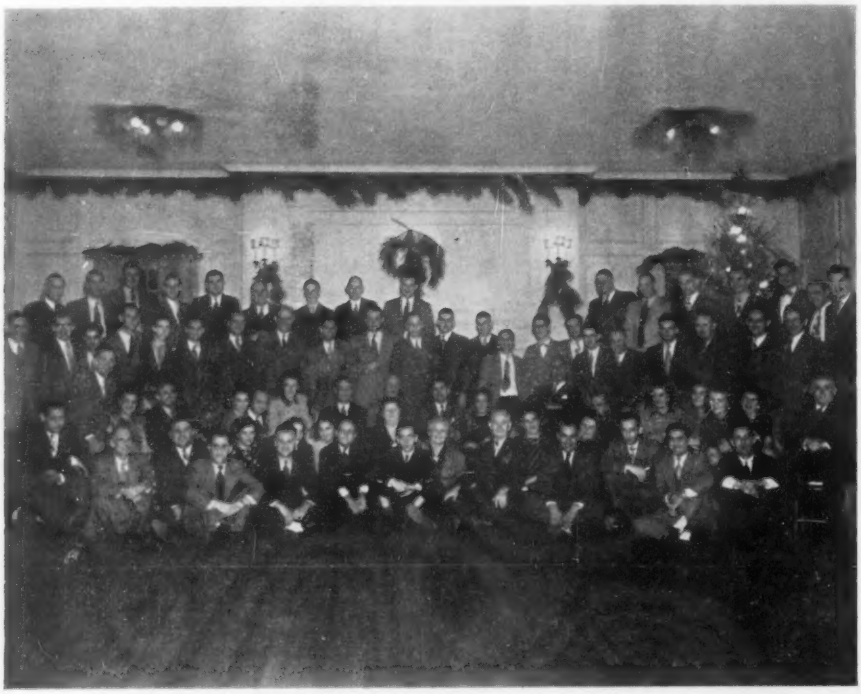
Specifications are as follows:

1. Efficiencies over 72% at full load up to 83% at 20% load.
2. Tap switch adjustment of output provides voltage adjustment without breaking current to the tank.
3. Newest design selenium elements over 7,700 square inches of effective rectifying area (approx. 310 square inches per 100 amps.) Triple impregnated for corrosion protection.
4. Ball bearing fans.
5. Positive overload protection.
6. Magnetic starter and push buttons.
7. Weston Meters and shunt.
8. Tygon lined.
9. Mounted on casters for mobility.
10. Dimensions—69" high by 26" deep by 38" wide. Input 200-220-440 volts, 30-60 cycles.

Business Items

Lea Holds 25th Anniversary Party

The Lea Mfg. Co., Waterbury, Conn.



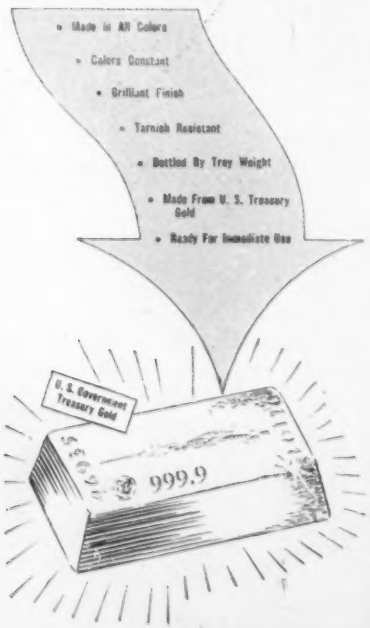
manufacturers of polishing, buffing and burring compositions, gave a 25th Anniversary dinner and party at the Waterbury Country Club to the entire office and production force numbering some seventy-five people. The "old timers" in the organization were especially honored. Several have been with the company since Bob Leather started it back in 1923, others more than twenty years, and quite a few over fifteen years. Service awards were given out for 5, 10, 15, 20 and 25 year periods of service. This continued service on the part of a constantly enlarging list of employees and the steady growth of the company, provide ample evidence of the progressive and sound policies of the company and of the high quality of its management-employee relationship.

H-VW-M Transfers Norton

Robert M. Norton, who has been the New York State Manager of the *Hanson-Van Winkle-Munning Company*, with headquarters in Skaneateles, has been transferred to the company headquarters in *Matawan, N. J.*, where he will be engaged in sales promotional activities in the sale of electroplating and polishing equipment and supplies.

Mr. Norton has been with the company for a number of years. He is

DAVIS - K GOLD PLATING SOLUTIONS HEADQUARTERS


• Made in All Colors
• Colors Constant
• Brilliant Finish
• Tarnish Resistant
• Bottled By Troy Weight
• Made From U. S. Treasury Gold
• Ready For Immediate Use
U. S. Government Treasury Gold
999.9

Davis-K's years of experience in the manufacture of Gold Plating Solutions, have developed and produced for the plater, a Gold Plating Solution that is effortless and fool-proof in its handling. Easily understandable too, since "experience is the best teacher" and only "Certified U. S. Government Treasury Gold" and the highest quality (C.P.) Chemicals are used. Davis-K Gold Plating Solutions are bottled by Troy weight in all "color-constant", popular shades. Are tarnish-resistant and ready for immediate use. When you're thinking of gold plating or have a plating problem—call on Davis-K!

DAVIS-K Service

Our service today with its newly expanded facilities is fast and efficient. Phone or write your precious metal plating problems. We welcome them!

RHODIUM Plating Solutions

Davis-K are distributors of Bakers' lustrous RHODIUM solutions, that produce a long-lasting white finish.

"Where Glittering Elegance Reflects Lasting Quality."

100% PURE GOLD DKP PRECIOUS METAL SOLUTION

DAVIS-K PRODUCTS CO.

54 West 22nd St. ORegon 4-4018-9 New York 10, N. Y.

Robert M. Norton

a graduate of Dartmouth College and has taken special courses in chemistry at Rutgers University.

Harris Appointed to Darco Board

Edgar W. Harris, Director of Sales, *Darco Corporation*, 60 *E. 42nd St.*,

Edgar W. Harris

N. Y. C., was elected a member of the Board of Directors at a meeting of the Board in Wilmington, Del., January 28, 1948. Mr. Harris started with Darco in 1931. He will continue his headquarters at the company's General Sales offices in New York.

Arthur Sprague Joins Midwest Research

Arthur Sprague Osborn, Kansas City, Missouri, has been appointed to the technical staff of the *Midwest Research Institute*, according to an announcement made public today by *Dr. Harold Vagtborg*, president of the organization. Mr. Osborn will be assigned to the Engineering Mechanics Department and will be working in mechanics and electro-mechanical design and analysis. He has been employed as the senior design engineer for the *Minneapolis-Honeywell Company, Minneapolis*, and more recently with *Aireon Manufacturing Company* in the production engineering department.

Mr. Osborn is a graduate of Kansas City Junior College and has attended the University of Illinois, Urbana, and the University of Wisconsin, Madison. He is a member of the National Society for Professional Engineers and a registered professional engineer of the state of Missouri. He holds two patents and two copyrights on technical publications and has numerous patents in various stages of process.

Merger of Automatic Temperature Control Companies

The merger of *Robertshaw Thermostat Company*, of Youngwood, Pa., *The Fulton Sylphon Company*, of Knoxville, Tenn., and the *Bridgeport Thermostat Company, Inc.*, of Bridgeport, Conn., under the name of Robertshaw-Fulton Controls Company was announced by *John A. Robertshaw*, President of the new organization.

WILLIAMSVILLE
Buffs
The WILLIAMSVILLE BUFF MFG. Co.
EST 1893
A1 ®
DANIELSON, CONNECTICUT
ONGER wear—harder cutting! Williamsville CUTMASTER Buffs have the cloth cut on the bias—the best for either automatic or hand buffing. Whatever your requirements, Williamsville can satisfy your specific needs.
QUALITY—DURABILITY
SINCE 1893
The WILLIAMSVILLE BUFF MFG. Co.
DANIELSON, CONNECTICUT

Now You Can Have Highest Test Pure Water for Plating at only 5¢ per 1000 gallons!

NEW BARNSTEAD

UPFLO Demineralizers

Have 3 Important Advantages

1 New Efficiency Lowers Cost per Gallon
The combination of improved synthetic resins and the UPFLO method of operation result in much higher purity and at the same time lower operating costs. Depending on the amount of minerals to be removed from the raw water this may well be as low as 5¢ per 1000 gallons.

2 Regenerating Time Cut Nearly in Half
Another advantage of UPFLO operation is that "backwashing" is entirely eliminated. This important saving in labor represents a considerable reduction in operating costs and further reduces the cost of the water.

3 Package Unit — Easy to Install
Barnstead UPFLO Demineralizers come completely assembled with all inter-connecting piping, gang-operated valves, and built-in regenerating tanks. They are compact, efficient units, ruggedly constructed with handsome stainless steel cabinets and console type control panels. They need only be connected to raw water supply and waste to start operating. Ready for immediate delivery. Send for Bulletin 117 and prices.

FIRST IN PURE WATER SINCE 1878

235 Lanesville Terrace — Barnstead STILL & STERILIZER CO. Inc. — Forest Hills, Boston 31, Mass

J. V. Giesler, President of the Fulton Sylphon Company and Bridgeport Thermostat Company at the time of the merger, was elected Executive Vice President of the new firm, in charge of the Fulton Sylphon Division, Knoxville, Tenn., and Bridgeport Thermostat Division, Bridgeport, Connecticut. *T. T. Arden* was elected Executive Vice President in charge of the Grayson Controls Division, Lynwood, Cal.

Udylite Appoints Young

Appointment of *William Young* as Udylite representative covering the Cincinnati territory, which includes most of southern Ohio, is announced by *L. V. Nagle*, vice president and sales manager of *Udylite Corporation*, 1651 *E. Grand Blvd., Detroit, Mich.*

William Young

Young, who will work out of the Cleveland office, has been with Udylite since 1944 as an equipment engineer. Prior to this he was associated with *Chrysler Corporation* in Evansville, Indiana, the *Great Lakes Steel Co.* in Detroit, and *National Tube Company* of Lorain, Ohio, over a fifteen year period.

Savage Promoted by Standard Plating Rack

Max Schneider, president of the *Standard Plating Rack Co. of Chicago, Ill.*, announces the elevation of *Frank Savage* to Vice President.

Mr. Savage, who became connected with the company in August 1947, came from the *Kuehne Mfg. Co.*, of Mattoon, Ill., where he served as Superintendent of the Metal Division. Previously, he was connected with *C. G. Conn Ltd.* of Elkhart, Ind., in several capacities, the most recent being that of General Superintendent.

Frank Savage

Mr. Savage is the author of several papers on electroplating, is past president of the Chicago branch of the *American Electroplaters' Society* and is immediate past supreme president of the society. He is a graduate of the Chemical Engineering School of Michigan State College.

Pennsalt Appoints Hardcastle to Board

The board of directors of the Pennsylvania Salt Manufacturing Company has elected *Y. F. Hardcastle*, Pennsalt vice-president in charge of manufacturing, as a board member, it was

Y. F. Hardcastle

announced recently by *Leonard T. Beale*, company president.

Mr. Hardcastle has been vice-president since 1927 and in this capacity supervised the 98-year-old chemical company's manufacturing operations through the period of its greatest expansion.

Joining Pennsalt's engineering department at the Wyandotte, Mich., plant in 1909, Mr. Hardcastle the following year was named supervisor of the plant's electrolytic operations.

He continued in that position until 1915, when he was made superintendent at Wyandotte, largest of Pennsalt's present seven plants.

After being named vice-president, Mr. Hardcastle remained at Wyandotte until 1932, when he moved to the company's executive offices in Philadelphia.

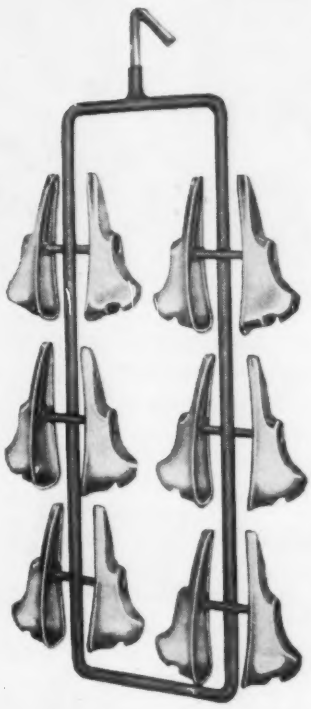
A native of Easton, Maryland, Mr. Hardcastle, now 64, was graduated from Lehigh University in 1906 with the degree of electro metallurgical engineer.

Mr. Hardcastle is a director of the Main Belting Company, Philadelphia, and is a member of the American Electro Chemical Society, the Philadelphia Chamber of Commerce and the Chemist Club of New York.

Frederic B. Stevens, Inc., of Detroit Moves to New and Larger Quarters

Frederic B. Stevens, Inc., of Detroit, Mich.—one of the country's oldest and best known distributors of foundry and metal finishing equipment and supplies; full and semi-automatic plating

NEW RACK INSULATION



No. 1000 is excellent insulation for racks and fixtures used in electroplating, anodizing, electro polishing, phosphate coatings and electro forming.

100% Solids

BUNATOL No. 1000 Paste Insulation is all solids. No inflammable liquids. No evaporation. No loss.

A single dipped coat gives a very thick and extremely tough insulation which far outwears ordinary types of insulation and at less cost.

Paste Insulation can be used successfully by anyone in any shop and with a great saving in labor. Simple to handle and quick;—insulation job completed in less than two hours. If you have an oven to bake racks you can save money and increase production with No. 1000 Paste Insulation. Write for information.

NELSON J. QUINN COMPANY
TOLEDO 7, OHIO

BUNATOL

GENERAL OFFICES AND WAREHOUSE, 18TH STREET AT VERNOR HIGHWAY WEST

PAINT REALLY STICKS

WHEN METAL PARTS ARE THOROUGHLY CLEANED IN A

BLAKESLEE

METAL PARTS WASHER

To assure 100% grease free surfaces for subsequent finishes to automobile bodies, refrigerators, washing machines, toys and hundreds of other products, choose a Blakeslee Metal Parts Washer, especially adaptable to the cleaning of metal parts prior to surface treatment. Blakeslee sprays are designed to reach all surfaces and each machine is "tailor made" to do a specific cleaning job. From our experience in handling every metal piece from small watch parts to diesel engine crankcases, we have been able to build a washing machine designed to do a perfect job and to last for years.

Write for FREE booklet on Blakeslee Metal Parts Washers to answer your particular cleaning problems.

G. S. BLAKESLEE & CO.

BLACOSOLV DEGREASERS AND SOLVENT

NIAGARA METAL PARTS WASHERS

G. S. BLAKESLEE CO., CHICAGO 50, ILLINOIS
NEW YORK, N. Y. TORONTO, ONT.

machines and buffing and polishing lathes, announce the removal of their General Offices and Warehouse to new and larger quarters.

The company had occupied the building at 510 Third Street for more than forty-five years. However, the Wayne County Road Commission recently condemned the building to make room for civic improvements—depressed express highways, etc.

In their new location at 1800 18*th Street at Vernor Highway West*, the company will enjoy greatly expanded facilities, with more than double the floor space previously occupied.

Their new building, of steel and reinforced concrete three stories high, is directly back of the Michigan Central Railroad Station. Another building which adjoins it is now being altered and will, within a few months, be occupied as their buffing composition factory. The new buildings are but a few minutes bus or taxi ride from the downtown business section.

The Stevens Organization, headed by *Mr. W. J. Cluff*, President, extends a cordial invitation to all their customers and friends to visit the new plant when in Detroit.

Holtmeier Forms New Corporation to Handle Buffing & Polishing Equipment

W. J. Holtmeier, for the past twelve years Eastern Manager for *Hammond*

W. J. Holtmeier

Machinery Builders, Inc., has announced the formation of his own corporation, which will be known as *W. J. Holtmeier, Inc.*, specializing in the sale of grinding, polishing, buffing and abrasive belt machines in all conventional types, including semi-automatics, buffers, rotary automatics and straitline buffers as well as a complete line of buffing lathes, composition feeders and accessories.

Prior to managing the Eastern Branch office for Hammond, he was also Sales and Advertising Manager, and played an important part in the development and sale of most of the machines which are offered for sale today.

He is offering his services as a specialist and consultant on polishing and finishing machinery in the Eastern States and is well qualified with twenty-eight years of experience in the field. His offices are located at 71 *West 23rd St., New York* 10, *N. Y.*, where he has been for the last ten years.

Randall Welding Works Changes Name

The *Randall Welding Works*, widely known for its expert craftsmanship in the fabrication of plating equipment during the past decade, has been incorporated under the *Randall Manu-*

facturing Co., Inc. The officers are *David Randall*, President, *Max Randall*, Vice President in charge of technical development, and *Martin Randall*, in charge of sales.

The corporation has installed a new 250 ton press brake which will facilitate the production of their tanks, degreasers, automatic washing machines, driers, lathes and many other specially engineered fabrications.

Cowles Appoints Sessions-Gifford as New England Distributors

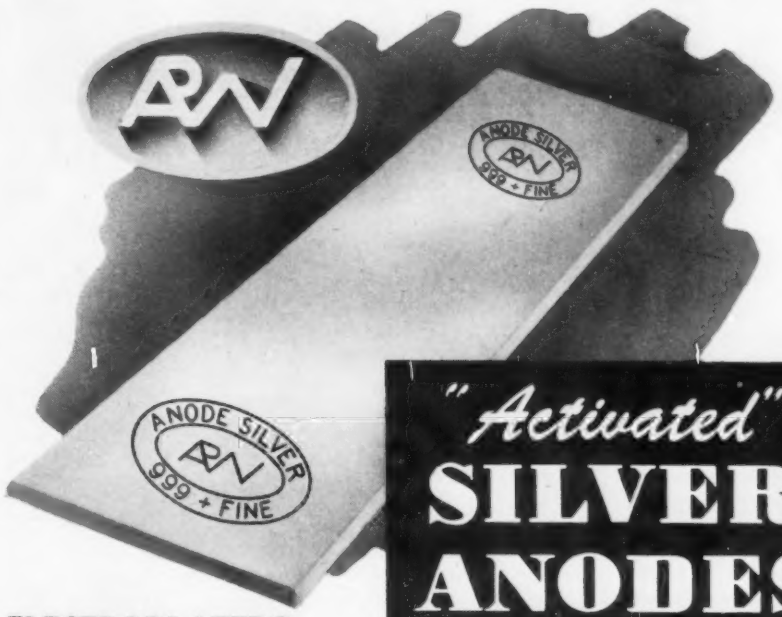
The Cowles Detergent Co., Cleveland, O. is pleased to announce to the metal working industries of New England the appointment of the *Sessions-Gifford Co., Inc. of Providence, R. I.* and *Boston, Mass.* as distributors of the complete Cowles line of alkaline and emulsion solvent type metal cleaners. Members of the experienced and competent sales organization of this old, established chemical distributor will cover all of the New England states. Sessions-Gifford Co. will maintain complete stocks of Cowles metal cleaners at convenient locations in this area and the technical service for which Cowles is noted will be available on request. Also, the services of the Cowles Metal Cleaner laboratory in Cleveland will be available to all Sessions-Gifford customers without obligation.

Du Pont Top Executives Promoted

Crawford H. Greenewalt became the tenth president of *E. I. du Pont de Nemours & Co.*, while *Walter S. Carpenter, Jr.*, was elected chairman of the Board, it was announced following the regular monthly meeting of the Board of Directors. Mr. Carpenter's resignation as president, and his designation as chairman of the Board, followed the retirement of *Lammot du Pont* from the latter post. Mr. du Pont's action brings to a conclusion a career in the company that began in 1902, and one that played a large part in the expansion and diversification of the company's activities.

In addition to assuming the presidency of the company, Mr. Greenewalt became chairman of the Executive Committee, of which he had previously been vice chairman, and a member of the Finance Committee.

Mr. du Pont will continue as a member of the Board, while Mr. Carpenter retains his membership on the Finance Committee.



"Activated"
SILVER
ANODES

ELECTROPLATERS . . .

Here's an improved fine silver anode that will insure top quality plating DAY-IN AND DAY-OUT.

APW "Activated" Silver Anodes are manufactured according to an exclusive process developed by APW research and every order is "job-tested" before shipment. They dissolve more cleanly and evenly—do not darken, shed or develop passive spots.

Your saving—cleaner—brighter—better plated products.

Already widely used in the silver plating industry, these "AA" grade anodes are available in any size and quantity for prompt delivery.

Send us your next inquiry and we shall be glad to send you full information and current quotations.

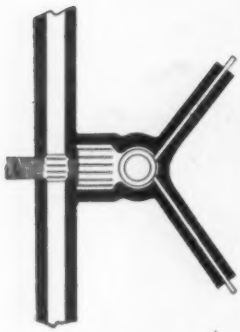
Also
APW Silver
CYANIDE
100 and 1000
ounce drums.

THE AMERICAN PLATINUM WORKS
231 NEW JERSEY R.R. AVE., NEWARK 5, N. J.

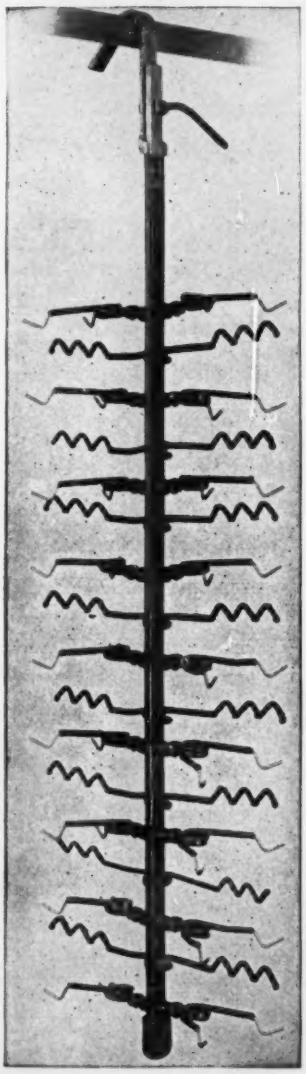
FLEXO
Copper Wire

Bare copper wire in coils or spools in all gauges for plating use. Prompt shipment. Catalog No. 60 on request.

FLEXO WIRE CO.
OSWEGO, NEW YORK



RACKS IS OUR BUSINESS



We know racks. We make better racks. That's our business . . . better racks for electroplaters. We've made them scientifically for over nine years. And we make all kinds of racks for every kind of plating job.

Here's an example. Standard Plating Rack Company makes the Du-All Universal Plating Rack. This is a single rack with a multiplicity of uses . . . an all-purpose plating rack offering platers the latest design in efficiency and economy.

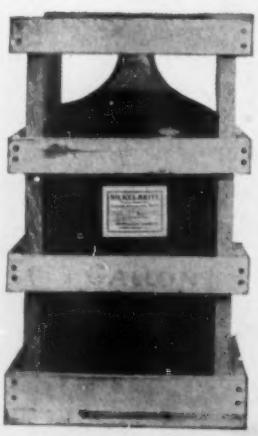
The Du-All provides holding attachments that accommodate a wide variety of shapes and sizes. Adjustable for regular or specialized plating jobs. Permit practically all inside and outside plating requirements. Speed production. Cut costs.

The Du-All has Stand-It-All Flexible Insulation. This insulation, featured on most of Standard's racks, prevents robbing of current . . . eliminates plating material loss. A perfect insulation in all standard solutions.

Another feature of this rack is the Du-All Anode Rack Attachment which insures efficient inside plating. And excessive current is no problem when the Du-All is used with the Insulated Octopus Feeder.

Scientific development has made the Standard Du-All Plaing Rack indispensable in your shop. All of our racks are constantly being improved through research. Specify Standard when ordering racks.

STANDARD
PLATING RACK COMPANY
1911-1925 North Paulina Street
Chicago 22, Ill.



Use NICKEL-BRITE
(REG. U. S. PAT. OFF.)
FOR NICKEL PLATING

"Nickel-Brite" eliminates color buffing and burnishing after plating. Indispensable for small work. "Nickel-Brite" works equally well in conveyors, plating barrels or still tanks—one-half pint required per 100 gal. nickel solution. Order today.

1 Gallon Bottles $5.00
5 Gallon Carboy . . . $4.75 per gallon

Plater's Remedies

I-HEAL-U Ointment
For Cyanide Sores

NICKEL-ITCH Ointment
For Nickel-Platers Itch

CHROME Ointment
For Chrome Sores

TRIAL OFFER — NO RISK

Either Remedy 3-oz. jar $1.00 or 12 jars $11.00 — 1-lb. jar $3.75

WAMBAUGH CHEMICAL CO.
1005 S. 9th — GOSHEN, INDIANA

At the same time it was announced that *Walter J. Beadle*, a vice president and member of the Board, had resigned as treasurer of the company and had been elected to membership on the Executive Committee. *T. C. Davis*, who had been first assistant treasurer, was elected treasurer to replace Mr. Beadle.

Pennsalt Names Cox Assistant Secretary

Warner R. Over, Secretary and Treasurer of the *Pennsylvania Salt Manufacturing Company, Phila., Pa.*, has announced the appointment of *Thomas W. Cox* as Assistant Secretary of the Company.

The appointment of Mr. Cox follows the retirement of *U. Grant Beath*, Assistant Secretary and Assistant Treasurer, after 47 years' service with the Company.

Mr. Cox, who joined Pennsalt in 1903, has been an Assistant Treasurer since September, 1944. He will continue as an Assistant Treasurer in addition to assuming his new post.

Mr. Over announced at the same time the appointments of *Stanley L. MacMillan*, who is in charge of the department's cost accounting, as an Assistant Treasurer; and *Joseph Doherty* as Credit Manager of the Company. Mr. Beath had also functioned as Credit Manager.

E. J. Harrington, Jr., an Assistant Treasurer, will act as Manager of the Sales Accounting Division, Mr. Over also announced.

Expansion of Industrial Research at Wichita

Expansion of the University of Wichita Foundation for Industrial Research has been necessary due to a steady influx of research projects from Kansas industry. The addition of three technical men and several part time graduate and student assistants brings the staff to approximately twice its size as of several months ago. The additions to the Foundation personnel are *Arthur C. Risser*, industrial designer; *La Rue Wangerin*, agricultural and research engineer; and *Arthur M. Lennie*, industrial consultant and metallurgical engineer.

This centralization of trained research personnel will be of invaluable aid to Kansas industry in developing new products and finding new markets. *Dr. Burnett*, director of the Foundation, in announcing these appointments called attention to the variety of technical backgrounds represented

and pointed out that the Foundation would be able to not only offer a greatly expanded service but a wider variety of technical aid to industrial firms.

In addition to the personnel additions, the Foundation has recently acquired much new scientific equipment which further expands its services and value to the area.

Industrial Lining Engineers Expands Line

The Industrial Lining Engineers, Inc., has recently expanded its line of established products and services to include products manufactured by the following:

Belke Manufacturing Co.
Crown Rheostate & Supply Co.
General Electric Co.
Wyandotte Chemical Corp.
United Chromium Corp.
Sparkler Manufacturing Co.
Manderscheid Co.
American Buff Co.
Nelson Chemical Co.
Duluth Buff Co.
Alsop Engineering Corp.
Kirk & Blum Manufacturing Co.
Platecoil Division of Kold-Hold Manufacturing Co. and other leading manufacturers of plating equipment and supplies.

Their newly-created Electroplating Sales Division, headed by *W. B. Williams*, now is in a position to offer sales and service, technical engineering, and faster deliveries of all plating and finishing room equipment and supplies.

New Kelite Sales Offices in Columbus and Cincinnati

The Midwest Division of *Kelite Products, Inc.*, Los Angeles 43, Calif., manufacturers of industrial chemical cleaning materials, has opened new sales offices in Columbus with *Mr. J. F. Riley* as Manager, and in Cincinnati with *Mr. J. T. Nolan* as Manager. Other Kelite Midwest division offices are located in Minneapolis, Fond du Lac, Milwaukee, Rockford, Aurora, Chicago, South Bend, Indianapolis, Cleveland, Detroit, Kalamazoo, Grand Rapids, Peoria, and Lansing.

Brown Co. Opens Memphis Office

Brown Instrument Company has opened a new district office at 922 *Dermon Building, Third and Court streets, Memphis, Tenn.*, it was an-

FLAT • TOP is a *different* zinc anode. Its difference in shape alone is going to end some of the worst problems in your shop. But **FLAT • TOP** has 6 IMPORTANT ADVANTAGES —

FLAT • TOP'S distinctive appearance makes recognition *sure*. Stops mixing zinc with cadmium or tin balls. Eliminates dumping, saves time and material.

FLAT • TOP'S area is 20% to 25% greater than a ball. More weight per anode reduces loadings, cuts labor.

FLAT • TOP'S original shape retained — even when dissolved to 25%. A glance avoids incorrect reloading of the anode basket.

FLAT • TOP is 99.99% *pure* zinc, highest purity anode zinc available. Not readily obtainable from general smelting sources.

FLAT • TOP is smooth. No gates or flash to hang on basket wires.

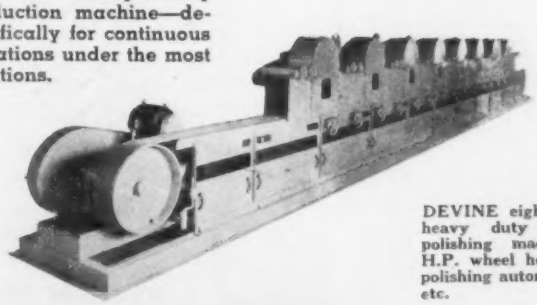
FLAT • TOP'S tight keg prevents contamination from second hand containers. 250 lb. keg is easily stacked, rolled and trucked.

Yes, **FLAT • TOP** *saves — in every way — yet is the SAME PRICE as troublesome ball anodes in fragile bags or battered drums. Sold by qualified metal finishing supply houses only.*

METAL FINISHING EQUIPMENT
Wagner BROTHERS INC.
POLISHING AND PLATING MATERIALS
418 Midland Avenue
Detroit 3, Michigan

STRAIGHT LINE POLISHING and BUFFING
. . . for high-speed, quality production!

Investigate this exceptionally rugged production machine—designed specifically for continuous buffing operations under the most severe conditions.



DEVINE eight unit type H heavy duty straight line polishing machine with 10 H.P. wheel heads. Used for polishing automobile bumpers, etc.

EQUIPMENT — SUPPLIES
PLATING PRODUCTS
352 MULBERRY ST. NEWARK 2, N. J.
Telephone MArket 3-3392

For Buffing and Polishing

Turn 'em out *FAST* ...with a VANOTT!

A fine, new way for the hand-work shop

●

A BETTER way for the shop already buffing by machine

●

Write for further information or send samples for our estimate

● YOU can lick mounting postwar costs with the *volume production* you get from a Vanott, 8-Spindle Buffing Machine.

Not only does this fine-quality Vanott machine increase production two or three times over handwork, but it also brings you maximum savings in buffing . . . the operation that often costs more than all others combined.

You'll find that a Vanott 8-Spindle Buffing Machine does the job better, too, turning out articles of almost any shape, up to 3" diameter (or 7" when using four spindles) with an excellent overall finish obtained by *uniform pressure* against the buffing wheel.

We'll be glad to make a production-cost estimate based on samples of your work in rough and finished condition. No obligation, of course.

VANOTT MACHINE CORP.
220 Colgate Avenue
Buffalo 20, New York

CHROMIUM
NICKEL
COPPER

Simple test sets for controlling these and other solutions available.

Write for Literature

KOCOUR CO.
4802 S. ST. LOUIS AVE.
CHICAGO 32

Specify Kocour Sets from your supplier.

nounced last month by *W. H. Steinkamp*, field sales manager for the industrial division of *Minneapolis Honeywell Regulator Company*.

The opening of the Memphis district office marks, said Steinkamp, the third move of a similar nature since the first of the year. Other offices have been established at Denver and Salt Lake City.

Pennsalt Announces Three Sales Personnel Changes

Three sales personnel changes in the

Albert H. Clem

Special Chemicals Division of the *Pennsylvania Salt Manufacturing Co.*, including the appointment of *Albert H. Clem* to a newly-created position as Field Sales Supervisor, have been announced by *Joseph J. Duffy, Jr.*, Manager of Sales.

Mr. Clem in his new position will supervise activities of the District Sales

Philip C. Staples, Jr.

Robert R. Pierce

Managers and all field men of the Division. A graduate of the Pennsylvania State College with a degree in chemical engineering, Mr. Clem has been with Pennsalt since 1938, when he became Detroit Sales representative.

Philip C. Staples, Jr., who has been with the Company since 1937, will succeed Clem as Product Supervisor on cleaners and pickling and descaling products. A Harvard University graduate, Mr. Staples brings to his new assignment a variety of experience including service in the Company's student training course, Technical Service Department and Sales Department, having formerly been Product Supervisor of another group of Special Chemicals Division products.

Succeeding Mr. Staples as Product Supervisor on corrosion-resistant products will be *Robert R. Pierce*, a graduate of Oregon State College with a degree in chemical engineering, who joined Pennsalt in 1941.

Both Mr. Clem and Mr. Staples are members of the *American Electroplaters' Society*. Mr. Pierce is a member of the *American Institute of Chemical Engineers* and *The American Electroplaters' Society*.

Bob Klaas On the Mend

The many friends of *Bob Klaas*, energetic vice president of *Divine Brothers Company*, will be glad to hear that he is rapidly recovering from a broken leg received while horseback riding last Fall.

Bob is now up and around—leg braced, but it is slowing him up but slightly.

To Remove Buffing Compounds from Brass

— *do it the* **PERMAG** *way!*

Electroplaters usually find the compounds from the buffing wheel hard to remove; small particles cling obstinately to the metal and are sure to mar the finish.

The remedy is the PERMAG PRE-SOAK—the precleaner that removes every trace of oil, grease, inorganic surface dirt and permits the final electrolytic cleaning solution to give the metal surface an absolute chemically clean surface for subsequent finishing. Our Special PERMAG Cleaner is easy to use and works fast, thorough, economically. Used successfully in leading plating shops.

When difficult plating problems arise, our Technical Service men are always ready to help bring the solution. Be free to write or 'phone us.

PERMAG is now in its 25th year of service to the Electroplating industry —and better prepared than ever to help solve the difficulties in the metal cleaning field.

MAGNUSON PRODUCTS CORPORATION

Mfrs. Specialized Cleaning Compounds for Industrial Purposes

Main Office: 50 COURT ST. BROOKLYN 2, N. Y.

In Canada: Canadian PERMAG Products, Ltd., Montreal-Toronto

YOU CAN'T MISS . . .

when you specify HARRISON

4A

buffing and polishing compounds!

Spray and Dip Compounds for Cutting and Mirror Finishing. Double-Header Compounds in sizes 150-180-220-240-320

• If your aim is faster cutting, increased production, greater economy . . . set your sights on Harrison 4-A Products. Our 25 years of experience exclusively with buffing and polishing compounds are your assurance of the *right* compound for the *right* metal . . . and of uniform, dependable quality as well. We will be glad to advise you on special problems and furnish samples of compounds that will meet your needs.

HARRISON & CO., INC. • HAVERHILL, MASS.

Save Time WITH Lustrebright

THE NEW IMPROVED

BRIGHT NICKEL PROCESS

ELIMINATES COLOR BUFFING, RE-CLEANING AND RE-RACKING. AN IDEAL BASE FOR CHROMIUM

This improved Lustrebright produces uniform, brilliant, lustrous, adherent nickel deposits that may be chromium plated. Work comes from plating tanks with bright, fine-grained deposits. No color buffing or burnishing is required.

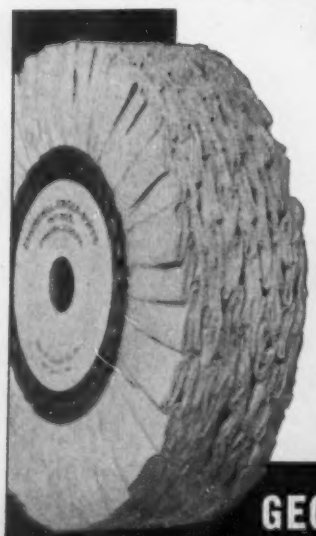
Lustrebright saves time . . . and money. Can be added to either your present lukewarm or cold nickel solution . . . no special solution or change in equipment necessary . . . and it's guaranteed not to harm plating solution. It provides continuous operation for all classes of work in still tanks or mechanical barrels.

It's low in cost and easy to control. Has been proven through extensive use in plating departments country-wide. Write for complete information.

W. C. BRATE COMPANY

14 MARKET STREET ALBANY 7, NEW YORK

Established 1860



Put the FINGER

on your Buffing Costs

USE

CHURCHILL FINGER-BUFFS

— AIR COOLED —

Faster Cutting — Lower Costs

Sole Mfrs.

GEO. R. CHURCHILL CO., INC.

NO. QUINCY 71, MASS.

Under U. S. Patents Nos. 2146284, 2350216. Others Pending.

Manufacturers' Literature

Belke Bulletin on Plating Conveyors

Describes in detail Belke Variable Speed, Semi-Automatic Conveyors for electro plating. Tells how they increase plating production, produce high quality plating, save labor and reduce plating costs.

Copy of Bulletin mailed promptly on request to the *Belke Manufacturing Co., 947 N. Cicero Ave., Dept. MF, Chicago 51, Ill.*

Lupomatic Tumbling Barrel Bulletins

Lupomatic Industries, Inc., Dept. MF, 4510 Bullard Ave., New York 66, N. Y.

Four new two-page bulletins have been issued by the above firm, which illustrate and describe tumbling barrels of several types for cutting down, deburring, burnishing and polishing metal and plastic parts.

They are: (1) Dry process single tumbler barrels: (2) Multiple unit barrels for wet or dry process, heavy production work: (3) Wet process, single and multiple units: (4) Wet Ball Burnishing Machines for burnishing and polishing jewelry and small metal parts.

These bulletins also describe compounds and give general recommendations for the compounds to be used for ordinary wet or dry tumbling processes.

A separate bulletin has been issued which gives complete processes and suggestions for proper compounds and carriers to be used under certain conditions of finishing work on metal and plastic parts.

A copy of any one or all five bulletins will be sent on request.

Manhattan Rubber Issues New Catalog

Printing of the Sixth Edition of *"Manhattan Rubber Products for Industry"*, a condensed catalog of mechanical rubber goods, has been completed by the *Manhattan Rubber Division, Raybestos-Manhattan, Inc., Passaic, N. J.* Copies are available on request.

Described in this catalog are many

mechanical rubber products and special items manufactured by Manhattan Rubber. Particular emphasis is given transmission and conveyor belting, V-belts, hose, engineered molded products, rubber roll coverings, tank linings, and abrasive wheels.

Divine Bros. Issues New Bulletin

Divine Brothers Co., Utica 1, *N. Y.* manufacturers of buffing and polishing wheels, machinery and supplies, has recently issued a new bulletin and price list covering a new, improved "Flexspeed" variable speed lathe for buffing and polishing.

The new Flexspeed is available in 3, 5, and 7½ H.P. sizes. It features a simple handwheel adjustment for changing the spindle speed through a range of 1800 to 3500 RPM. The operating speed is easily read from a speed indicator mounted on the top front of the lathe.

Buffing and polishing wheels operate to best advantage at a predetermined "Surface-feet-per-minute", so this new Flexspeed gives the user the added economy of being able to use the correct wheel speed — even on wheels which have been worn down from their original diameter. In other words, the speed adjustment allows for compensation of loss of diameter of the buff or polishing wheel without sacrifice of the efficiency of the correct surface speed—a real economy feature.

For further information, readers are invited to write for Flexspeed Bulletin VCSV-1.

Thermocouple and Pyrometers Accessories

A new Bulletin, No. P1235, covering thermocouples, protection tubes, and pyrometer accessories, has been published by *The Bristol Company, Waterbury, Conn.* The bulletin gives detailed drawings, complete information, and prices covering the accessories for pyrometers, which the company carries in stock for immediate shipment, at its main factory in Waterbury, and its branch factories in Akron, Chicago, and San Francisco. In addition, it contains a chart and valuable engineering data on selecting the right thermocouple and protection tube. Copies of the bulletin, No. P1235, are available by writing to The Bristol Company, Waterbury 91, Conn., Dept. MF.

A QUALITY PRODUCT FOR QUALITY WORK

NO. 471 SPEEDIE STAINLESS STEEL COMPOSITION — JOB PROVED

It makes little difference whether you run a job or production shop. If you are buffing stainless steel you naturally want the best composition available to turn out the maximum amount of work.

No. 471 SPEEDIE Stainless Steel Composition is not a new material. It has been marketed for many years, years in which it has had every opportunity to prove that it does a superb job of cutting down scratches, pit marks or gray color, and at the same time imparts a high color to the finished article.

SPEEDIE Stainless Steel Compositions have been tried and proved on all types of work, and have come through with flying colors. Automobile molding, cutlery and plumbing fixtures are just a few of the many products which have been successfully buffed with SPEEDIE Stainless Steel Compounds.

Don't take our word for it! Find out for yourself how SPEEDIE Stainless Steel Compositions will lick that tough buffing job you have. Write today for samples.

And while you're at it, ask for a copy of the brand new catalog which has just been received from the printers. Chock full of vital information that will interest every buffing and polishing shop.

No obligation, of course.

Tripoli • Grease Stick • Lime Finish • Chrome • Emery Cake • Satin Finish

Polishing Room Supplies and Accessories

BP **THE BUCKEYE PRODUCTS CO.**
7033 Vine Street Cincinnati 16, Ohio
Cable address: Buckprod

PLATING GENERATORS

COMPLETE WITH CONTROLLING EQUIPMENT
THOROUGHLY RECONDITIONED & GUARANTEED
EXCELLENT VALUES WHILE THEY LAST

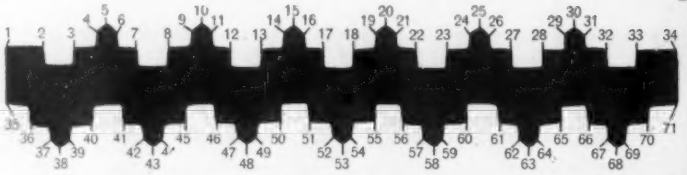
1—CHAS. J. BOGUE ELECTRIC CO. M.G. SET—40 KW, 5000/2500 Amp., 8/16 volts, 490 RPM, Twin Commutators, Sep. Exc. (220/3/60 Motor). PRICE $3250.00.
1—JANTZ AND LEIST M.G. SET—5000 Amp., 3 to 8 V, 430 RPM, Interpole, Sep. Exc. (220/3/60 Motor). PRICE $3450.00.
1—JANTZ AND LEIST M.G. SET—6000 Amp., 3 to 6 V, 430 RPM, Interpole, Sep. Exc. (220/3/60 Motor). PRICE $3450.00.
1—EAGER ELECTRIC CO. M.G. SET—5000/2500 Amp., 6/12 V, 490 RPM, Sep. Exc. (550/3/60 Motor). PRICE $3000.00.
1—EAGER ELECTRIC CO. M.G. SET—5000/2500 Amp., 6/12 V, 490 RPM, Sep. Exc. (220/3/60 Motor). PRICE $3000.00.
1—HANSON-VAN WINKLE CO. 4000/2000 Amp., 6/12 V, 490 RPM, (220/440 V Motor), Sep. Exc. PRICE $3000.00.
1—GENERAL ELECTRIC CO. 2000/1000 Amp., 6/12 V, 1200 RPM, (220/3/60 Motor). PRICE $1650.00.
1—HANSON-VAN WINKLE CO. 4000/2000 Amp., 3/6 V, 490 RPM, (550/3/60 Motor). PRICE $2250.00.

IMMEDIATE DELIVERY

M. E. BAKER COMPANY
143 Sidney Street Cambridge 39, Massachusetts

how DIVCO Self-Scrubbing Action Increases Chrome Plating Efficiency

71 throwing edges on Divco Anodes produce violent agitation with self-scrubbing action that sweeps surfaces clean and eliminates stagnation — Just count the 71 throwing edges.



Improved Chrome Plating Quality— *FASTER* with Reduced Cost

You can see the increased turbulence that demonstrates fast plating action the minute you put Divco 71-Point Lead Anodes to work. Pound for Pound they cost no more than ordinary anodes. Equip a tank and compare results.

***AVOID SUBSTITUTES*—Look for "Divco" beneath the hook or count the 71 edges. Order from your jobber or direct.**

"A Good Name Carries Weight"

Division Lead Co.

821 W. Kinzie St. Chicago 22, Ill.

Other DIVCO PRODUCTS

LEAD

Antimonial — Chemical — Tellurium

in Pipe — Sheet — Foil or Fabricated for All Plating Shop Requirements

THE BRONZE THAT LOOKS LIKE GOLD!

SPEKYELLO

U. S. PATENT NO. 2,198,365

Color Range Simulates from 14Kt. to a Pink Gold Color

SPEKYELLO is easy to operate . . . produces a uniform color, eliminates troublesome color matching . . . has extremely high throwing power, plates uniformly on flat surfaces and deep recesses. Plates directly over brass, copper, nickel, german silver, iron and steel; also over all hard solders and most soft solders. Can also be used as an underplate.

Write for Catalog and Prices

SPECIAL CHEMICALS CORP. 30 IRVING PLACE NEW YORK 3, N. Y.

Selenium Rectifiers

The Seletron Division, Radio Receptor Co., Inc., Dept. MF, New York 11, *N. Y.*

Announcement is made by the above firm of a line of selenium power rectifyers available through jobbers. A five-page bulletin with illustrations describes selenium rectifiers for d-c requirements having range of voltage and currents and lists electrical characteristics and dimensions. The nineteen selected Seletron rectifiers are those most frquently required by small manufacturers, public utilities, laboratories, maintenance departments, test departments, railroad hobbyists, plating hobbyists, and radio amateurs.

Associations and Societies

AMERICAN ELECTROPLATERS' SOCIETY

Convention News

The Annual American Electroplaters Society Convention for 1948 will be held in *Atlantic City* on *June* 28-*July* 1. This year the *Newark Branch* will be the hosts, and have appointed *Mr. Horace Smith* as general chairman. Mr. Smith's long association with the Society (Past Supreme President for 2 terms and a Charter Member) should go a long way towards making this year's meeting one of the best ever held, as he is fully aware of what it takes and how to go about running a successful affair of this kind.

The Annual Convention is the year's outstanding event for plating and finishing men, at which time each member can listen to the atuhorities in the field discuss the important developments, and can enter into the discussions and perhaps get the answers to his own problems.

Aside from the purely technical sessions, there is also the opportunity to see the latest in the way of new equipment, materials, and processes, and to discuss them first hand with the representatives of various manufacturers. Exhibitors and visitors alike welcome this chance to discuss mutual problems.

The various committees are now hard at work to insure the success of the convention, including a Ladies

Committee to see that the distaff side of the family thoroughly enjoys the event. With all the non-technical attractions that Atlantic City has to offer, such as bathing, golfing, horse-racing, and just plain loafing along the Boardwalk, members who come to this convention without their "better-halfs" are either outright brutes or else they are wasting their time and should be in politics.

Milwaukee Branch

The Milwaukee Branch of the *American Electroplaters Society* will hold its Annual Educational Meeting and Banquet at the Schroeder Hotel, Milwaukee, on Saturday, April 24, 1948.

The speakers and their subjects will be announced later.

The Educational Session will start at 2:00 P. M. and will be followed by the Banquet at 7:00 P. M. after which will be music and entertainment.

Rochester Branch

The regular monthly meeting of the Rochester Branch, A.E.S. was held Friday, Jan. 16, 1948 at the Hotel Seneca.

Three applications for membership were accepted:

Albert E. Drews, Plating Foreman, *Wollensak Optical Co.*

George T. Bowles, Jewelry Supt., Mt. Morris, *Hickok Mfg. Co.*

Clarence Chishester, Plating Foreman, Mt. Morris, *Hickok Mfg. Co.*

Mr. Ray Berghold was commended for the fine job of attending to the details of the Christmas Party held at the 40 & 8 Post, which was attended and enjoyed by 40 couples.

The Spring Regional Educational Meeting will be held Saturday, April 24, 1948.

Laurence Ridpath has requested a transfer from the Newark N. J. Branch.

The speaker for the evening was *Dr. Henry Strow*, Chief Chemist for the *McDermid Co.* Dr. Strow gave an unusually comprehensive talk on Bright Copper. Numerous questions by the members were answered by the speaker.

An attendance of around 40 members and guests in zero weather was complimentary to our speaker.

ANNOUNCING

Divine

BELTFLEX

CONTACT WHEELS

Give positive polishing action on light contour and radius work where resilient action is necessary.

FLEXIBLE—They mold the belt to the work surely and effectively.

BALANCED—for smooth running, and to give constantly accurate pressure to the working surface. A smoothly ground face assures uniformity.

TWO DEGREES OF DENSITY—one offering greater flexibility, the other more aggressive cutting action . . . both giving pliability and resilience beyond standard contact wheels.

WIDE SIZE RANGE—face widths and diameters for most requirements. Wheel equipped with metal hub. Generally most effective when used with Jeans Cloth (J weight) belts.

Divine Brothers Company

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ANA

BRAND

Buffing and Polishing Compositions

Cleaning Compounds

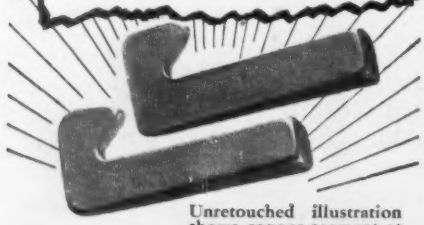
Personal services to each customer a specialty

A. N. AUSTIN CO., Pequabuck, Conn.

ROTO FINISH
Trademark Reg. U. S. Pat. Office
DOES CUT PRODUCTION COSTS

ELECTRICAL MFR. WRITES . . . . . .
(Name on File)

"The savings effected in this one job alone are outstanding. Roto-Finish has enabled us to increase the production of one assembled unit from 94 units per day to 300 per day by releasing five regular operators who ordinarily would be assembling the units from a tedious filing job."



Unretouched illustration shows copper segment at top before Roto-Finish deburring and finishing; below after Roto-Finishing.

Roto-Finish is a mechanical deburring and finishing process — producing staggering savings in labor costs over manual operations. One operator can finish quantities of parts uniformly and accurately in a fraction of the time required by hand. Roto-Finish likewise removes a job that is tedious, time consuming and distasteful to employees. It eliminates need of elaborate, costly dust control systems. Send samples of die castings, sand castings, stampings, machined parts, forgings for processing. (Include finished part for guide.) No obligation!

THE STURGIS PRODUCTS CO.
416 JACOB ST., STURGIS, MICHIGAN

ROTO-FINISH
THE ENGINEERED
MECHANICAL FINISHING PROCESS

Los Angeles Branch

What the Los Angeles Fire Department has accomplished with respect to preparing and enforcing regulations pertaining to dangerous chemicals, under an ordinance enacted by the city in 1947 as an aftermath of the explosion of the O'Connor Plating Company plant, was explained at the meeting of *The Los Angeles Branch, A.E.S.*, on February 11 by *Captain C. W. Bahme*, head of the dangerous chemical division of the department's fire prevention bureau.

Capt. Bahme declared that while the explosion of a tank of perchloric acid in the O'Connor shop had for a time centered unusual interest in the explosive potentialities of that chemical, department records show that there have been other accidents from mishandling of perchloric acid which during the past five years have resulted in some 30 deaths and 100 injuries in Los Angeles County alone.

He cautioned platers not to be misled by these figures into thinking that perchloric acid was the most dangerous of chemicals. Authoritative sources list more than 100 chemicals in the "dangerous" category, the properties and peculiarities of which should be known by all who have the handling of them. He stressed, too, the fact that plating shop owners should familiarize themselves with the combinations of chemicals which singly are comparatively safe, but which, coming into contact with another chemical, result in a volatile product of destructive potentiality.

Capt. Bahme cautioned shop owners not only to report the existence of chemicals subject to explosion from contact with water but also advised them to post a warning sign on the outside of the shop so that the firefighters might know what awaits them on the inside, and can act accordingly.

Concerning the enforcement of regulations pertaining to dangerous chemicals, Captain Bahme declared that the Fire Prevention Bureau is endeavoring to obtain information and data from all groups which the ordinance effects, in order to arrive at fair, yet safe, regulatory procedure for eliminating explosion hazards in plants in which dangerous chemicals are handled.

The Bureau has studied ordinances on dangerous chemicals now operative in other cities and is trying to arrive at an effective program which would exempt reasonable amounts of chemicals which are needed for working purposes from the strict provisions of the present ordinances, which call for storage of all dangerous chemicals in fireproof vaults and under careful segregation.

The second speaker on the program arranged by Librarian *John M. Millhorn* was *George W. Slomin* of the *Electrochemical Engineering Laboratory* of Los Angeles. Mr. Slomin spoke on the deposition of copper from various solutions, devoting considerable time to fluoboric solutions and the "know how" of solution preparation and plating technique.

Following a 20 minute lecture on

Remove Copper with McKEON'S "Liquid Sulphur"
TRADE MARK REG'D

ASK
SULPHUR PRODUCTS CO.
Greensburg, Pa.

the subject, Mr. Slomin answered questions from the members. Fluoboric acid solutions seemed to be a subject on which the members sought lengthy information.

Three new members were initiated by President *Howard Woodward*. These were: *E. J. Mooney* of the Modern Plating Co.; *Carlyle L. Farmer* of Pacific Airmotive Corp.; and *Thomas W. Ward* of the J. W. Lesser Co.

The annual educational session and dinner dance of Los Angeles Branch will be held at the *Los Angeles Breakfast Club*, 3201 Los Feliz Drive, on March 20.

National Instrument Conference and Exhibit

The Third Instrument Conference and Exhibit will be held at the Philadelphia Convention Hall, September 13-17, 1948.

The Conference and Exhibit is sponsored by the *Instrument Society of America* with the cooperation of the following:

American Institute of Physics
Industrial Instruments and Regulators Committee of the *American Society of Mechanical Engineers*
Instruments and Measurements Committee of the *American Institute of Electrical Engineers.*

ELECTROCHEMICAL SOCIETY

Columbus Convention

The Spring Convention of *The Electrochemical Society* will be held April 14-17, at Columbus, Ohio. Headquarters for this meeting will be at the *Deshler-Wallick Hotel.*

Dr. Charles L. Faust, of Battelle Memorial Institute, is the Chairman for the convention, which will feature symposia on Corrosion, Electronics, and Electrothermics.

Reservations should be made as far in advance as possible, as a large attendance is anticipated.

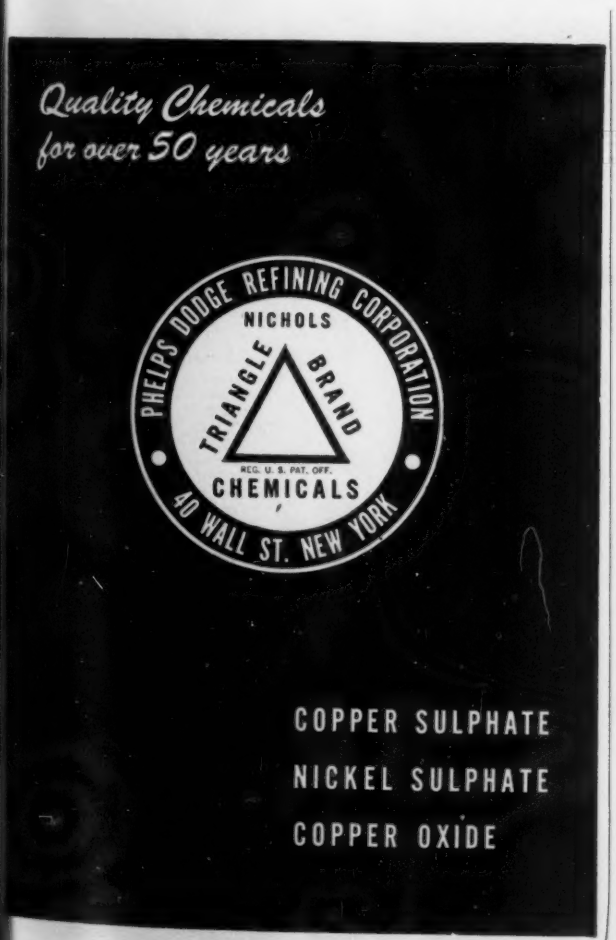
1948 Annual Meeting of the American Society for Testing Materials

The 1948 Annual Meeting of the *American Society for Testing Materials*, is to be held in Detroit beginning June 21. There will be some 20 technical sessions, with a large number of technical papers and reports in the field of materials. There will be more than 300 meetings of the Society's technical committees, concentrating their work on standards and research in materials. Throughout the week of the meeting the Society's 8th Exhibit of Testing Apparatus and Related Equipment will be in progress.

One of the most interesting features of the meeting will be the 1948 Edgar Marburg Lecture to be delivered by *Dr. Paul Aebersold*, Chief of the Isotopes Division, Atomic Energy Commission, Oak Ridge, Tenn.

A.S.T.M. President *T. A. Boyd*, General Motors Research Laboratories, will give the annual presidents address at the Dinner on Wednesday, June 23.

Topics to be covered by the formal symposiums, or special sessions include the following: Symposium on Conditioning and Weathering; Creep, Stress Rupture and Short-Time High-Temperature Tension Testing; Round-Table Discussion on Spot Identifica-



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tion Test; Symposium on Mineral Aggregates, Symposium on Magnetic Testing, Symposium on Latest Methods of X-Ray and Gamma-Ray Inspection, and others. Several of the technical committees of the Society are sponsoring the symposiums.

Dr. Von Karman to Receive Medal for Scientific Achievement

Dr. Theodore von Karman, aeronautical engineer, has been selected to receive the 1948 John Fritz Medal for scientific achievement, it was announced yesterday by the Board of Award of The American Society of Mechanical Engineers.

Dr. von Karman was cited as a "creative leader, stimulating teacher and wise counselor in engineering and physical research in the fields of the aeronautical and structural sciences, for his many applications of mathematical and physical theory to the sound solution of engineering problems."

Dr. von Karman directed the Army Air Corps Jet Propulsion Project at the California Institute of Technology.

He became consultant for the Army Air Forces in 1939 and adviser at Wright Field.

In 1944 he was made special consultant to General Henry H. Arnold and director of the Army Air Forces Scientific Advisory Group.

Von Karman has also received the Gold Medal of The American Society of Mechanical Engineers in 1941, and the Medal of Merit in 1946. He is a member of the National Academy of Sciences, the Royal Society of London, the French Academy of Sciences; an Honorary Fellow of the Institute of the Aeronautical Sciences and a member of the Ordnance Association.

N.A.C.E. 1948 Conference and Exhibition

The 1948 Conference and Exhibition sponsored by the *National Association of Corrosion Engineers* will be held Monday through Thursday, April 5-8, at the *Hotel Jefferson, St. Louis, Mo.* The four-day session will include an extensive technical program, as well as an All-Corrosion Exhibition.

The technical program will consist of ten symposia at which approximately forty papers on corrosion, its causes, and methods for combating it, will be presented by corrosion authorities. The symposia will include *Cathodic Protection, Protective Coatings for Metals,* and *Salt Water Corrosion.*

At the All-Corrosion Exhibition, various manufacturers will present displays of the latest materials, methods, and equipment for combating corrosion.

ASME

The nation is coming into an era of stream pollution abatement as the result of an increasingly insistent demand by the public, *J. R. Hoffert* of *Harrisburg, Pa.*, told the process industries session of the Annual Meeting of The *American Society of Mechanical Engineers*, held Dec. 5, 1947, at Atlantic City.

Pollution from industrial wastes has grown by leaps and bounds in recent years, especially in industrial areas, the speaker said. As a result, "many

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public water supplies have been jeopardized or destroyed; industries have been put to great additional expense for water treatment or have had to seek new locations.

As an example of the rising standard for the purity of streams, Mr. Hoffert pointed out that the present anti-pollution statutes of Pennsylvania are not limited to the effects of sewage and industrial wastes upon the public health, as was the first act of 1905, but include their effect as well upon public and industrial water supplies, fish and aquatic life and the recreational use of streams.

Although efforts have been made in all of the recent sessions of Congress to enact legislation giving the federal government control over stream pollution, Mr. Hoffert does not believe federal action is necessary to most inter-state pollution problems when the affected states desire to meet their obligations. Inter-state agreements and compacts of various types have proven very effective.

The speaker said that many modern treatment works are becoming increasingly mechanized and are literally factories for turning noxious substances into inoxious end products or by-products.

Pollution abatement is the concern of all citizens, said the engineer, since "it is going to cost a lot of money" which will be paid partly in the form of taxes and partly in the increased cost of the products of industry.

NEW BOOKS

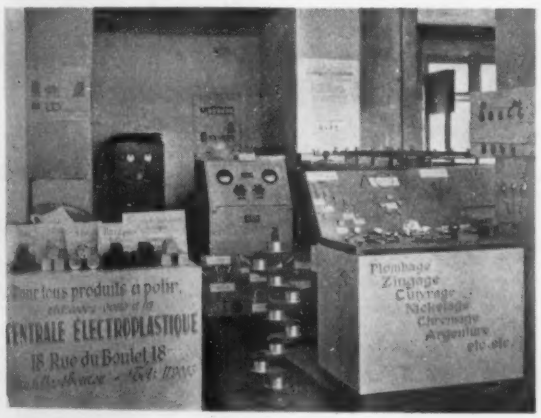
S.P.I. Handbook

Published by the *Society of The Plastics Industry, Inc., 295 Madison Ave., New York 17, N. Y.* Price—Members $4.50, Non-Members $7.50.

Reflecting the four years of painstaking and accurate work required for its preparation, the *S.P.I. Handbook* is now available as the most authoritative reference book on Plastics ever published. The list of contributors and authors contains the names of a host of authorities on each and every phase of the subject, and reads like the "Who's Who" of the plastics engineering field. The eleven chapters, covering 430 pages, treat the subject in the most detailed and precise manner, from the classification of materials down to the finishing and assembly operations. The book is particularly well illustrated, and contains over 500 charts and illustrations. In this respect the chapter on Mold Design is outstanding, having over 70 pictures of the various types of molds described in the text. While emphasis is primarily on molded and extruded materials and their fabrication, there is also included a very complete chapter on the less glamorous, but extremely important laminates, with recommendations for all types of fabricating operations.

This book will appeal to molders, manufacturers, and users alike, and is a must for the engineering library of everyone conected even remotely with plastics.

W.A.R.



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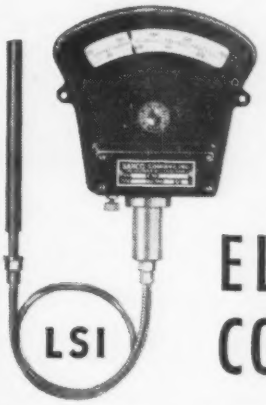

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A.S.T.M. Standards on Soaps and Other Detergents

In addition to the 24 specifications and 7 test methods covering numerous soaps and detergents, this compilation, sponsored by the *American Society for Testing Materials* through its Committee D-12 on Soaps and Other Detergents, includes an extensive bibliography of metal cleaning which has 375 references, many of them with annotated abstracts.

The specifications in this November 1947 publication cover the following: bar soap; various kinds of chip soap; powder soaps; salt water, olive oil and palm oil solid soaps; and various types of toilet soaps.

Detergents for which there are specifications include: borax; soda ash; soda, caustic; soda, modified; sodium bicarbonate, metasilicate, and sesquisilicate; trisodium phosphate; and tetrasodium pyrophosphate.

The test methods and analytical procedures which comprise a considerable portion of the book cover the sampling and chemical analysis of soaps and soap products, special detergents, sulfonated and sulfated oils, and metal cleaning composition. There are tests covering corrosion of water soluble aluminum cleaners, and a series of definitions of terms relating to soaps and other detergents.

Copies of this 180-page compilation, heavy paper cover, may be procured from A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa. at $2.00 each.

News from California

By Fred A. Herr

Fire at the plant of *Automatic Polishers, Inc.*, 1851 *Randolph Street, Los Angeles*, on February 10 gutted the polishing building and caused estimated damage to building and equipment of $35,000. Sparks from buffing operations which ignited lint, are believed to have been the cause.

Two other production buildings, one housing the plating department, the other the die cast department, were undamaged. Replacement of the wrecked structure is to be undertaken immediately, it was reported. The combined building units represented the largest aluminum electro-polishing plant on the West Coast (See August, 1947, METAL FINISHING, Page 63).

Richards Rack Co. of Los Angeles in mid-February completed an enlargement program which more than doubled its factory area at 643 South Santa Fe Avenue. *Al Richards*, president, reported the expansion, which was started in November, involved the addition to the existing plant of more floor area in the same building, as well as the installation of some $8,000 worth of new equipment for stepping up the production of specially designed plating racks.

Two courses with appeal to members of the electro-plating and industrial finishing fields are included in the spring classes of the Engineering Extension Division, *University of California at Los Angeles.*

One class, with *Mitchell Raskin* as instructor, involves a comprehensive survey of the science, technique and practices involved in the various methods employed in electro-plating for those engaged in some aspect of the field who wish to broaden their knowledge and experience.

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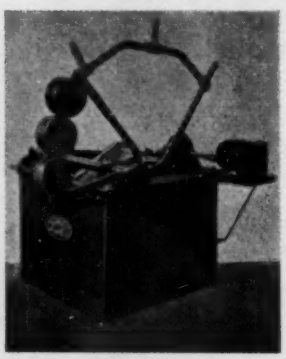

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The other course, taught by *Lester Morris*, deals with high polymers in protective and decorative coatings. It includes physical and chemical properties of high polymers, analysis of competitive products, physical chemistry of films and solutions, organisols, plastisols and lastices.

Beginning February 17, classes in both courses are being held one night a week from 7 to 9:30 o'clock.

Western Chemical Co. has announced plans for construction of a new warehouse and office building costing an estimated $70,000, at Phoenix, Ariz.

Wiser Mfg. Co., manufacturers and finishers of building hardware, have announced construction of a building addition, to its plant at 8641 Otis Ave., South Gate, Calif.

Hollymade Hardware Mfg. Co., Los Angeles, in February had brought its new construction plans to the stage where bids were to be taken for construction of a new factory building, including paint booths and a paint room for the finishing of manufactured hardware items.

The *Auto-Lite Co.* of Toledo, O., has announced plans for the construction of a new plant for the manufacture of storage batteries at Compton Boulevard, near Garfield Avenue, Clearwater, Calif. Construction is scheduled to start as soon as steel deliveries are made, and the manufacture of batteries is expected to get under way in the fall of the year.

Alfred C. Beachlin has been appointed representative in Phoenix, Ariz., for *Illinois Testing Laboratories*, producers of the Alnor line of scientific measuring instruments.

Changes in the West Coast executive setup of *Federated Metals Division* are as follows: *Louis D. Albert* appointed assistant general manager for the Pacific Coast; *John S. Selfridge, Jr.*, named superintendent of San Francisco plant, and *Robert C. Caldwell*, assistant superintendent.

Letters to the Editor

Editor,

Dear Sir:

In the December issue, page 89 and 90, under "Shop Problems," headed "Discolored Chromium Plate," I should like to add this bit of additional information:

"Rainbow effect may also be caused by improper chromic acid to sulphate ratio. I have observed that this effect is most likely to occur at a ratio of 100:1 *or higher, particularly in low current density areas. Furthermore, yellow patches or spots may likewise appear as a result. For this reason it is preferable to keep the chromic acid to sulphate ratio at approximately* 95:1.

"Rainbow effect" may also be caused by too high chlorine content in the bath. Too high chlorine content will also cause milky deposits.

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S. G.

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Complete heavy duty input line and plug eliminates installation problems.

Model	D. C. Amps.	D. C. Volts	A. C. Volts	Phase
3424	25	0-6	115	Single
1110	100	0-8	115	"
2239	150	0-8	115	"
SPC 2512T	250	0-8	220	"
TC 5050	500	6	220	Three

RAPID ELECTRIC CO.
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Editor
Metal Finishing
Dear Sir:

Recently I encountered a problem, the solution of which may be of interest to other readers of *Metal Finishing* who may find themselves in a similar predicament.

A workman was told to paint the inside of a cement tank with a tar base acid-proof paint. Instead of the cement tank, he smeared the paint thoroughly over the rubber lining of another tank nearby. After trying several methods of trying to get this paint off without affecting the rubber, the following treatment was found to be very satisfactory:

50 oz. of ammonia water were mixed with 50 oz. of Turpentine. This was used on a cloth to wipe off the tar. No evidence of any damage to the rubber lining could be detected.

Yours truly,

A. V. R.

An Apology and a Warning

In the January issue of *Metal Finishing* an answer to a reader's Shop Problem was given in which Perchloric and Acetic Acids were mentioned as ingredients for a bath that could be used for electropolishing Lead. The response was overwhelming, as many letters were received chastising your humble servant for not pointing out the dangers involved in careless application of this mixture, which was responsible for the disastrous explosion in California last year.

Extreme care should be used when working with this mixture, and only small quantities should be mixed together if experimental work is being done with it.

Apparently it was erroneous to assume that everyone investigating electropolishing solutions knew of the potential hazards of the mixture.

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Technical Books Wanted

An urgent appeal for donations of scientific and technical books and periodicals is being made for shipment to Finland, where the library of the *Teknillinen Korkeakoulu* (*Technical Institute*), one of the leading technical schools of that country, was completely destroyed during the war by bombs. In the efforts for recovery that the Finns are making, the lack of technical library facilities is a very serious handicap. It would be a practical act of friendship to a nation that holds America in high regard if Americans should contribute good technical books and periodicals to this library.

Any such gifts should be marked for the *Institute of Technology, Helsinki*, and sent to the *Legation of Finland*, 2144 *Wyoming Avenue, N. W., Washington, D. C. Dr. K. T. Jutila*, the Finnish Minister, will arrange for their shipment to Finland.

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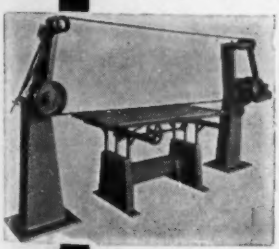
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6 U.S. Elec. Buffers Model 95 5 H.P. 4 speed machines
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1 Blakeslee Degreaser Barrel type fully automatic steam heated type PHLL 6760
1 Richardson Tumbling Unit 6 Bbl. Tilting Type
14 Baird Tumbling Barrels tilting type No. 1 and 2
3 Ransohoff Automatic Sawdust Drying Machines
1 Sturgis Tumbler
6 Lupomatic Horizontal Tumblers
2 Horizontal Plating Barrels
1 50 Gallon Pressure Tank, w/motor driven agitator
30 Semi Automatic Attachments w/single spindle semi automatic attachments

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1—750 Ampere, 15 volt, Star.
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1—1000/500 Ampere, 12/24 volt, Hanson-Van Winkle, synchronous, 900 RPM.
1—600 Ampere, 24 volt, Reliance.
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1—800 Ampere, 22/33 volt, General Electric.
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